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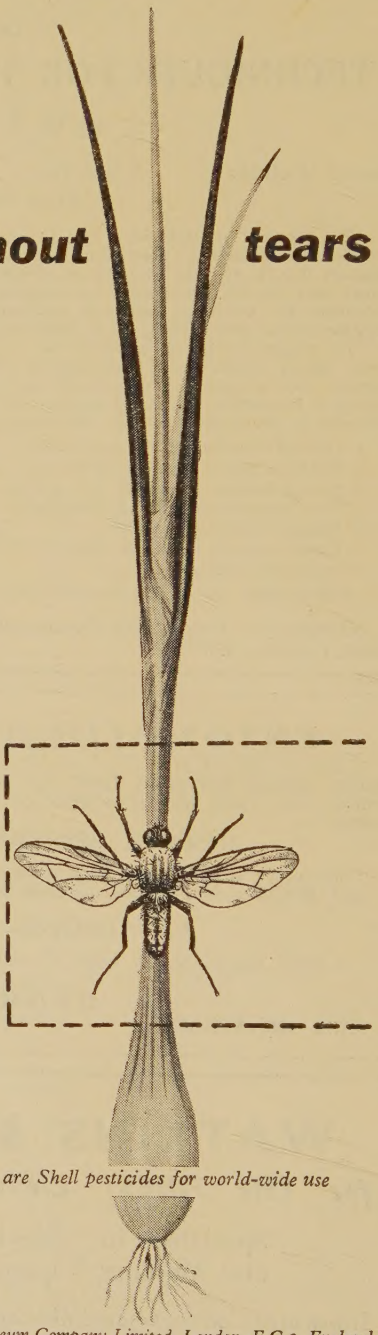

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Cultivation of the Cricket Bat Willow.—*Bull. For. Comm.* no. 17 (2nd edn.), vi + 33 pp., 16 pls., 3 figs., 35 refs. London, H.M.S.O., 1958. Price 5*s*.

This bulletin on the cultivation of willows for bat-making and other uses in Britain contains a chapter (pp. 14–18) in which notes are given on the bionomics and control of the insect pests that infest the trees, classified as those that feed on the leaves or cause galls on the stems, branches or shoots and those that bore in the wood.

Schedl (K. E.). **Der kleine Fichtennadelmarkwickler** (*Asthenia pygmaeana* **Hb.) in Südtirol.** [*A. pygmaeana* in the South Tyrol.]—*Heft Amt Statist. Stud. Reg. trentino-tirol. Etschland* no. 1, 38 [+3] pp., 9 pls., 10 figs., 9 refs. Trento, 1957.

An outbreak of *Asthenia pygmaeana* (Hb.) began in 1952 on spruce along the sides of several valleys in the Province of Alto Adige (South Tyrol), the distribution of which is shown on a map. The egg, larva and adults of this Tortricid are briefly described, its distribution in Europe is reviewed, and an account is given of observations on its bionomics, importance, natural enemies and control, carried out in 1954–55.

The adults emerged mainly in April, males somewhat before females, and eggs were laid at the base of the needles, chiefly on the lower surfaces of those of the previous year. The larvae hatched in 14–30 days and moved to the May shoots, where they bored into the unopened buds and fed on the young needles, later spinning the needles together to form nests. Feeding continued for 5–6 weeks and was mostly completed by the beginning of July. The larvae then left the trees on spun threads, entered the soil litter and pupated in cocoons, the pupae overwintering. The only parasite observed was *Trichogramma evanescens* Westw., which attacked 24 per cent. of the eggs in one locality in 1954 and an average of 14·2 per cent. in another in 1955, the maximum being 56·7 per cent. Infestation was most severe on trees standing free or at the edges of stands, and commoner on parts of the crown exposed to the sun. It led to the death of some of the shoots and a bushy growth, but little tree mortality.

Attempts at control by sprays or dusts applied to the litter in autumn were unsuccessful, but BHC fogs applied from static generators or the Swingfog machine [*cf. R.A.E.*, A **42** 393] in June, when the larvae were beginning to leave the trees, caused high mortality.

Issekutz (L.). **Der Weinstockschädling** *Theresimima ampelophaga* **Bayle-Barelle in Ungarn (Lepidopt., Zygaenidae).** [The Vine Pest, *T. ampelophaga*, in Hungary.]—*Z. wien. ent. Ges.* **42** nos. 3–5 pp. 33–43, 56–61, 75–80, 4 pls., 2 maps, 39 refs. Vienna, 1957.

An unusual outbreak of *Theresimima ampelophaga* (Bayle) occurred on vines on the upper slopes at Badacsony, near Lake Balaton, in May 1954. The author reviews the systematic position and distribution of this Zygaenid, describes all stages and gives a survey of the literature on its bionomics in Hungary and other parts of Europe. Larvae collected in the field were transferred to cages and supplied with vine leaves. Pupation began in early June, and adults emerged between 18th June and 1st July. Pairing occurred soon after emergence, and eggs were laid in groups of 20–80 on the lower surfaces of the leaves or cage tops, at the rate of about 200 per female. The larvae hatched in 6–8 days and were reared on vine leaves in petri dishes or glass jars. They spun cocoons at the end of July or beginning

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of August, and were placed outdoors in mid-October for overwintering. Activity was resumed at the end of April, and adults emerged in the second half of June, after a pupal stage lasting about a fortnight. Further material was collected in 1955, and similar results obtained. It was thus confirmed that the insect has only one generation a year in Hungary. About 20 per cent. of the larvae collected in 1954 were parasitised by *Apanteles lacteicolor* Vier., which had not previously been recorded from this host, but no parasites emerged from those collected in 1955. Control measures are briefly reviewed.

Opyrchałowa (J.). **Ziołomirek zmienny**—*Phytonomus variabilis* **Hrbst. (Coleoptera, Curculionidae) jako szkodnik lucerny na Śląsku.** [*Hypera variabilis* as a Pest of Lucerne in Silesia.]—*Polsk. Pismo ent.* **26** (1956) no. 23 pp. 331–365, 4 figs., 8 graphs, 82 refs. Wrocław, 1957. (With a Summary in French.)

Observations in 1952–54 on the bionomics of *Hypera* (*Phytonomus*) *variabilis* (Hbst.) on lucerne in Polish Silesia showed that the overwintered adults resume activity in the second half of April. Oviposition continues from then until August, but is most intense in late May and early June. The females lay 350–710 eggs each, with an average of 480, and the egg, larval and pupal stages last about 13, 25–35 and 10 days, respectively. Newly emerged adults are most numerous at the end of July, and they enter hibernation in late August and September, irrespective of temperature. The larvae were parasitised by *Bathyplectes curculionis* (Thoms.), and heavy mortality was caused by a fungus, *Cephalosporium acremonium*, in 1953. The weevil is seldom a serious pest in this region, since lucerne is cut during the first ten days of June and most of the young larvae and remaining eggs are removed with the hay, but it occasionally increases in old plantings.

Loomis (R. S.), Beck (S. D.) & Stauffer (J. F.). **The European Corn Borer, *Pyrausta nubilalis* (Hubn.), and its principal Host Plant. V. A chemical Study of Host Plant Resistance.**—*Plant Physiol.* **32** no. 5 pp. 379–385, 2 graphs, 27 refs. Lancaster, Pa., 1957.

In this part of a series [*cf. R.A.E.*, A **46** 382], an account is given of studies on the isolation and distribution of substances that inhibit the growth and survival of the larvae of *Pyrausta nubilalis* (Hb.) in maize plants, and the following is based on the authors' summary of the results. Several such substances were detected in aqueous extracts of maize plants, and quantitative estimations of their activity were obtained by bioassays with the fungus *Penicillium chrysogenum* and *Pyrausta nubilalis*. About half the activity shown by the extracts was due to an ether-soluble substance termed Resistance Factor A [*cf.* **46** 311], which was isolated and found to be 6-methoxy-2(3)-benzoxazolinone. This factor accumulated in the maize plant throughout its development, the leaves showing the highest content and the mature portions of the stem the lowest, and its distribution was consistent with the high mortality observed among larvae of *P. nubilalis* feeding on the leaves of young maize. The concentration found in young maize plants (about 0·2 mg. per g. fresh weight) was sufficient in synthetic diets to inhibit the growth of the larvae completely. The ether-insoluble residues of the aqueous extracts contained an additional inhibitor (or inhibitors) termed Resistance Factor B, which accounted for the other half of the activity shown.

Labeyrie (V.). **Influence de l'alimentation sur la ponte de la teigne de la pomme de terre** (*Gnorimoschema operculella* **Z.**) (**Lep. Gelechiidae**).—*Bull. Soc. ent. Fr.* **62** no. 3–4 pp. 64–67, 2 graphs, 7 refs. Paris, 1957.

Most authors have recorded the number of eggs laid by *Gnorimoschema operculella* (Zell.) as being not much more than 80 per female [*cf. R.A.E.*, A **41** 345; **45** 208], though the potential fecundity is much higher. They did not supply food for the moths, however, and a test was therefore made in France in which pairs of adults obtained from larvae that developed on potato at 27°C. [80·6°F.] and 70 per cent. relative humidity were kept without food or water, with water only or with water and honey. The females kept without food or water laid an average of 84 eggs each, with a maximum of 109, those kept with water, but no food, about twice as many, and those kept with water and honey almost three times as many, the absolute maximum being 336. Females kept without food or water ceased ovipositing after three days, whereas those supplied with both required eight days to lay 90 per cent. of their eggs, the peak being reached on the third day.

Ernst (E.). **Der Einfluss der Luftfeuchtigkeit auf Lebensdauer und Verhalten verschiedener Termitenarten.** [The Influence of Atmospheric Humidity on the Length of Life and Behaviour of various Species of Termites.]—*Acta trop.* **14** no. 2 pp. 97–156, 19 figs., 100 refs. Basle, 1957. (With Summaries in French and English.)

The following is based on the author's summary of this detailed account of laboratory experiments in which the termites used were *Kalotermes flavicollis* (F.) and *Reticulitermes lucifugus* (Rossi) (dry-wood and subterranean termites from southern Europe), *Zootermopsis nevadensis* (Hagen) (California damp-wood termite) and *Nasutitermes arboreus* (Smeathman), obtained from nests in trees in the Ivory Coast. Resistance to desiccation was determined by comparing the length of life of single termites without food at different relative humidities. It is confirmed that termites thrive best in very high humidities; in dry air, their life is much shorter. Grouped workers or soldiers of *Nasutitermes* lived longer than isolated individuals at all humidities, the social factor increasing their resistance. The differences in the duration of life of the four species corresponded well to the moisture conditions of their habitats. Behaviour was tested by studying the humidity reactions of the termites in gradients 30 cm. long, with the highest humidity either in the middle or at one end of the chamber. Tests with single termites gave no results, but groups of ten showed a characteristic distribution, influenced by thigmotaxis and social attraction. Further, behaviour depended on the physiological state of the insects, on the differences of humidity offered and on the range within which these differences lay. The four species differed in the time needed for positive reaction; *Nasutitermes* reacted within one hour, *Zootermopsis* within 5–6 hours, and *Reticulitermes* on the second and *Kalotermes* on the third day. It seems that the humidity receptors are mainly situated on the antennae, since humidity reactions were eliminated by removal of these.

Franz (J.) & Krieg (A.). **Virosen europäischer Forstinsekten.** [Viruses of European Forest Insects.]—*Z. PflKrankh.* **64** pt. 1 pp. 1–9, 47 refs. Stuttgart, 1957. (With a Summary in English.)

A list is given of 15 well characterised viruses that cause diseases in insect pests of forests in Europe, showing the countries in which they occur, their

importance in causing epizootics, whether or not their use for biological control has been attempted, the sites and type of the inclusion bodies, the type of virus agent concerned, the scientific name of the virus (when available) and references to descriptions in the literature. Two of them attack sawflies, and the rest Lepidoptera. Notes are given on their relations to their insect hosts and their transmission, reference is made to a few less well defined viruses of forest pests, and the minimum requirements for the description of insect viruses are reviewed.

Philipp (W.). **Verstärktes Auftreten der Zwetschengallmilbe** *Aceria* (= *Eriophyes*) *phloeocoptes* **Nal.** [Increased Infestation by the Plum Gall Mite, *A. phloeocoptes*.]—*Z. PflKrankh.* **64** pt. 1 pp. 35–38, 3 figs., 3 refs. Stuttgart, 1957. (With a Summary in English.)

Aceria (*Eriophyes*) *phloeocoptes* (Nal.), which is more widely distributed in Europe than heretofore thought, was particularly injurious in 1955–56 to plum in the part of the Rhine Valley known as the Bergstrasse. Damage was severe on trees of only one variety, on which the mite had apparently been common for years, though others were also infested, and consisted of galls on the twigs [*cf. R.A.E.*, A **43** 181]. The mites overwinter in these, eggs are found in them in spring, and the young mites leave in late May or early June, enter the bark, and cause the formation of new galls. Infestation results in dead twigs and, apparently, in the production of small, bitter fruits. The winter sprays commonly applied against *Quadraspidiotus perniciosus* (Comst.) afford little or no control of the mite, but treatment with suitable acaricides in spring might be more effective.

Schwerdtfeger (F.). **Pathogenese der Borkenkäfer-Epidemie 1946–1950 in Nordwestdeutschland.** [The Pathogenesis of the Bark-beetle Epidemic of 1946–50 in north-western Germany.]—*SchrReihe forstl. Fak. Univ. Göttingen u. Mitt. niedersächs. forstl. Versuchsanst.* **13–14,** 135 pp., 49 figs. Frankfurt-am-Main, J.D. Sauerländer's Verlag, 1955. (Abstr. in *Z. PflKrankh.* **64** pt. 2 pp. 120–121. Stuttgart, 1957.)

Thalenhorst (W.). **Grundzüge der Populationsdynamik des grossen Fichtenborkenkäfers** *Ips typographus* **L.** [Outlines of the Population Dynamics of *I. typographus*.]—*Op. cit.* **21,** 126 pp., 13 figs., 3½ pp. refs. 1958. (With a Summary in English.)

These two papers are complementary to one another and are concerned with the serious outbreak of *Ips typographus* (L.) that occurred on spruce in north-western Germany, principally in the Harz region, in 1946–50.

The first of them, in which the outbreak is dealt with largely as it affected the trees, is divided into three main sections. The first comprises a general review of the origin and course of the outbreak, with comparative data from southern Germany and elsewhere, in which it is shown that infestation was most intense towards the edges of the region and decreased in intensity towards the west [*cf. R.A.E.*, A **38** 145]. The main cause was failure to dispose of felled timber remaining from the war years [*cf.* **39** 32], and its course was much influenced by weather, principally high temperatures in the early years, notably 1947, which increased the aggressiveness of the beetle. Variations resulting from local conditions and precautions to be adopted in the future are discussed at some length. The second section is concerned with the factors on which attack on living trees depend. The requirements of the beetle are not critical as regards the physiological condition of the trees, but the tissues of the almost completely healthy spruce are apparently the most favourable, provided that the resin flow is

reduced by dry weather [*cf.* **43** 20]. In the third part, the effects of infestation on the living tree are described.

The second paper comprises an account of investigations on *I. typographus* made during the outbreak and includes sections on nutrition, the effect of population density on the rate of increase of the beetle, the effects of weather conditions, natural enemies, genetic factors and human activities on infestation, and the course of infestation in a single tree and in a particular stand, and a final section in which the author analyses the phases through which an outbreak passes. He considers that the main factor in the population dynamics of the bark-beetle is the balance between fertility and mortality. This is affected by the availability of felled, dead or dying trees, which offer no resistance to infestation, and conditions that modify the resistance of living trees, by the initial population density and the degree of intraspecific competition, by climatic factors, and by parasites and predators.

ZIMMERMANN (B.). **Beitrag zur Kenntnis des Entwicklungszyklus des Apfelwicklers, *Cydia pomonella* L., mit besonderer Berücksichtigung der zweiten Generation.** [Contribution to Knowledge on the developmental Cycle of *C. pomonella*, with particular Reference to the second Generation.]—*Z. angew. Ent.* **39** pt. 3 pp. 259–301, 20 graphs, 22 refs. Berlin, 1956.

A second generation of *Cydia pomonella* (L.) has been found to occur on apple in many parts of Germany with a mild climate, including Bonn [*cf. R.A.E.*, A **41** 289, etc.], and investigations on the life-cycle of the moth were carried out there in 1949–51 in order to facilitate control. The following is based largely on the author's summary of the results.

The first adults of the overwintered generation emerged at the beginning of May in 1949, the end of May in 1950 and the beginning of June in 1951. The emergence period lasted 6–8 weeks, continuing into the second half of July, and the flight period continued for at least a further fortnight, the moths becoming numerous only when the sum of average daily temperatures exceeding 15°C. [59°F.], calculated from the beginning of the year, had reached 400°C. [720°F.] (which occurred in the first half of June) and becoming rare, irrespective of weather, on 16th–19th July. Mass oviposition began in the first half of June, which is therefore the best time to begin spraying, and lasted about two months. The females laid a maximum of 95 eggs each. The eggs hatched in 6–12 days, and the larvae infested the fruits from June to the end of August or beginning of September, completing their development in 26–36 days. Only 1–15 per cent. of the larvae pupated before the winter, pupation occurring mainly in July. Adult emergence began in the last ten days of July or the first ten in August, so that adults of both overwintered and first generations were sometimes present simultaneously, and reached a maximum at the beginning of August. The last adults emerged at the end of August or the beginning of September. Oviposition began soon after and continued into September, and the females laid a maximum of 87 and an average of 61 eggs each. The larvae hatched in 6–11 days, and feeding continued until the end of September. Counts of infested fallen fruits showed that about 12–30 per cent. had been infested by larvae of the second generation, and collection of larvae from trap-bands in September–October showed that as many as 30 per cent., with an average of 10–15 per cent., belonged to the second generation. The amount of damage caused by this generation depended on the time of emergence of the adults of the overwintered generation and the proportion of first-generation larvae that pupated before the winter. If emergence of the overwintered

generation is heavy as well as early, spraying at that time should be supplemented by further applications at the end of July or the beginning of August.

Schmutterer (H.). **Zur Lebensweise und Bekämpfung des Grossen Rapsstengelrüsslers** *Ceuthorrhynchus napi* (**Gyll.**). [On the Bionomics and Control of *C. napi.*]—*Z. angew. Ent.* **39** pt. 3 pp. 302–315, 7 figs., 13 refs. Berlin, 1956. (With a Summary in English.)

No large outbreaks of *Ceutorhynchus napi* Gylh. on crucifers have been observed in most areas in Germany in the last few years [*cf. R.A.E.*, A **40** 323], but limited outbreaks sometimes occur on rape in western districts in places where this crop is cultivated each year, even though climatic conditions may be unfavourable for the weevil. An outbreak began near Giessen in the spring of 1954, following heavy mortality of the plants during the previous winter; almost all the plants were infested by larvae at the end of May, and the yield was poor. Counts of cocoons containing freshly emerged adults at the end of July showed that the population was very high. In 1955, rape was grown in an adjoining field, and investigations were carried out on the migration of the adults to this new breeding ground and on their control. Emergence from winter quarters began on 23rd March, the time of emergence depending on temperature, and observations on flight were made by means of yellow trap-dishes about 15 ins. square, as used in work with Aphids [*cf.* **39** 359]. It was dependent mainly on sunlight and was favoured by high temperature and calm weather. No flight took place in dull or very windy weather, whatever the temperature. The beetles flew readily but for short distances at a time. Colonisation of the adjoining field took place in several waves, gradually for a period of about two weeks, by which time the old breeding ground had become free of adults, and then more rapidly as adults flew in from further afield. It reached a maximum on about 10th–15th and virtually ended on 15th–20th April. No beetles were observed to reach the field by crawling. Oviposition began some 12–14 days after emergence from hibernation, and this is the best time for control on susceptible young winter rape. The insecticides tested comprised proprietary dusts of which the contents of active ingredient are not specified. One containing DDT and γ BHC (Aktiv-Gesarol [*cf.* **41** 291]) was applied about 5th April and proved effective only at an uneconomically high rate of application, its action being primarily a repellent one. The other materials were applied on 12th April, in some cases with a second application of the same or a different material on 22nd April. Cold weather followed the applications on both dates. The best results were given by a mixture of BHC and dieldrin (Neo-Tarsol). Dead adults were first observed 36 hours after treatment, mostly at the base of the plants, mortality was apparently almost complete after a few days, and one application almost completely eliminated malformation of the plants and stem splitting [*cf.* **30** 539]. Satisfactory results were also obtained with one application of BHC or parathion. Two applications were little better than one, since oviposition was almost over by the time of the second, which, furthermore, had considerable phytotoxic effect. Few plants on the control plots remained free of infestation.

Artificial infestation by inserting eggs of *C. napi* into the heart of rape or cabbage plants was rarely successful and no proliferation was induced [*cf.* **40** 323]. Transplanting parts of the female genitalia into test plants sometimes caused great proliferation, leading to splitting of the heart of cabbage plants. Similar tests with *C. quadridens* (Panz.) produced less violent effects.

Lyngnes (R.). **A useful Chalcidid,** *Trigonoderus tristis* **Walk.**—*Z. angew. Ent.* **39** pt. 3 pp. 368–375, 6 figs., 3 refs. Berlin, 1956. (With a Summary in German.)

During investigations, begun in 1948, on wood-boring insects in buildings in Sunnmöre, western Norway, adults of *Trigonoderus tristis* Wlk., a Cleonymid of which there has apparently been no record since 1836, were found frequently every year on infested wood. On one farm, they appeared in numbers in May on the beams of a rather warm, moist sheep-shed and in June on the rafters of an airy barn situated above it. In both cases, the wood was heavily infested by *Anobium punctatum* (Deg.). The abdomens of both sexes, the egg-laying apparatus of the female, and the processes of pairing and oviposition are described. The female, which matures about 20 eggs, bores into the wood with its ovipositor, penetrating a pupal chamber of *A. punctatum* close beneath the surface. Chambers that were opened after apparent oviposition were found to contain a larva, pupa or adult. No eggs of *T. tristis* were observed, but pupae of the latter, which are formed free, were found at the outer end of mines of *A. punctatum* and larvae that were probably those of *T. tristis* were found in the wood later in the summer. The new adults left the wood by gnawing their way out. *T. tristis* was second in importance to *Spathius exarator* (L.), adults of which were present in June–September and which, unlike *T. tristis*, attacked the larvae in their mines.

van de Vrie (M.). **Over de invloed van spintaantasting op de opbrengst en groei van vruchtbomen.** [The Effect of Mite Infestation on the Yield and Growth of Fruit Trees.]—*Tijdschr. PlZiekt.* **62** pt. 5 pp. 243–257, 9 figs., 24 refs. Wageningen, 1956. (With a Summary in English.)

The author reviews the effects of infestation by *Panonychus* (*Metatetranychus*) *ulmi* (Koch) on fruit trees [*cf. R.A.E.*, A **41** 140, 169] and describes experiments on apple in Holland in 1952 in the first of which the mite was controlled for the rest of the season by single sprays of 0·05 per cent. demeton [diethyl 2-(ethylthio)ethyl phosphorothioate] applied early in May, June, July or August, the treatment of the trees being otherwise uniform. Spraying in May prevented bronzing and premature shedding of the leaves, both of which became progressively more pronounced the longer mite control was delayed. There was little difference in the total weight of apples per tree, but the mean weight per fruit was reduced when spraying was delayed until June or later, with little difference between the three later dates. The growth of the new shoots and the number of blossom clusters in the following spring decreased progressively as the spraying date became later. In the second test, the mite was controlled in late May by a spray of 0·03 per cent. parathion with 0·05 per cent. Chlorocide [p-chlorobenzyl p-chlorophenyl sulphide], and the number of blossom clusters in the following spring was three times as great as on trees left unsprayed.

Strickland (A. H.). **Cabbage Aphid Assessment and Damage in England and Wales, 1946–55.**—*Plant Path.* **6** no. 1 pp. 1–9, 1 graph, 2 refs. London, 1957.

Losses in yield of brussels sprouts due to attack by *Brevicoryne brassicae* (L.) were investigated by means of data from plot trials of systemic insecticides at various places in England in 1951–55 and from extensive annual

surveys of Aphid populations in autumn on unsprayed crops throughout England and Wales in 1946–55. In the plot trials, plants were sprayed 1–3 times during the season, counts of Aphids on three-leaf samples were made at intervals of 2–4 weeks, and the approximate average densities on sprayed and unsprayed plants for each month from June to October were estimated from the bulked results. In general, insecticide treatment in mid-June reduced the average Aphid density in July from about six to about one per sample, and a second application in mid-August reduced the density in September from about 18 to about two. The insecticides were not completely effective, and the subsequent population trends were similar on both sprayed and unsprayed plants. More Aphids survived when the densities were high than when they were low. Statistical analysis showed the yield to be in general significantly and negatively correlated with the average maximum Aphid densities 6–8 and 12–14 weeks after planting out, which are reached about mid-July and mid-September, respectively, and are referred to as the early and seasonal peaks. It is further estimated that populations consisting of nine Aphids per sample in July and September cause losses of 3·9 and 4·7 cwt. per acre, respectively. Yields must show increases of at least 2·3 and 4·6 cwt. per acre to justify the cost of one and two applications of a systemic insecticide, and the population levels at which the use of insecticides becomes economic are discussed.

Few commercial crops are sprayed against the Aphid early in the season, and probably no more than 25 per cent. when the plants are approaching maturity, and the mean national monetary loss due to infestation is estimated at rather less than £1 million a year. The probable benefits to be derived from the use of insecticides are also estimated, and it is concluded that, although control in August or September is often of value, a greater general increase in yield could be obtained by maintaining the plants free from infestation immediately after planting out. Application of a systemic insecticide, of which the best are effective for 4–6 weeks under field conditions, to the seed-beds a week or two before transplanting might control migrants at relatively low cost.

Woodville (H. C.). **Control of Bulb Fly Damage in** *Narcissus*.—*Plant Path.* **6** no. 1 pp. 10–12. London, 1957.

Findings in Devonshire in 1953–54 regarding the efficacy of cold dips containing 0·2 per cent. aldrin or dieldrin for the protection of *Narcissus* bulbs from attack by *Merodon equestris* (F.) were confirmed in tests in 1955–56, in which these treatments gave complete protection from infestations reaching 42 per cent. in untreated bulbs of one variety and 55 per cent. in another and had no harmful effects. In trials at two places, bulbs of four varieties that were dipped in 0·2 per cent. aldrin or dieldrin for 15 minutes in 1954 and left in the ground for two years remained free from infestation throughout the first year and virtually so during the second. In the first year, there was no significant difference in the yield of flowers from treated and untreated bulbs, but in the second, considerably higher yields were obtained from the treated ones and, in addition, the foliage of the treated plants appeared healthier, the bulbs were heavier at lifting time, and there were no losses. Improved quality in bulbs at lifting time was also noted on a commercial holding on which dipping had been practised for several seasons. In further tests, similar immersion in 0·5 per cent. chlordane reduced the percentage infestation in bulbs of one variety in two plots from 50·5 and 60 to 1·2 and 2·5, respectively, and advanced the flowering date, and treatment with 0·12 per cent. heptachlor gave complete protection. There was no significant difference in the effectiveness of aldrin,

dieldrin and chlordane, but the last two cost twice and thrice as much, respectively, as aldrin. When a cold dip of aldrin or dieldrin is used in addition to the standard hot-water treatment, the crates in which the bulbs are contained must be of metal or, if of wood, they must be changed between the two treatments to avoid contamination of the hot-water bath by insecticide absorbed by the wood during the cold dip; the concentration of dieldrin shown in preliminary tests to be safe in the hot-water bath was 0·005 per cent.

The addition of 0·005 per cent. heptachlor or 0·0225 per cent. chlordane to the hot-water bath had no adverse effect on bulbs immersed for three hours at 110°F. in September 1955, while still dormant, and infestation after planting in two localities was reduced from 14 and 21 per cent. for no insecticide to 3·8 and 2·7 per cent. for heptachlor and 3·7 and 4·7 per cent. for chlordane, which again induced early flowering. The growth and flower yield of bulbs that were treated in two batches of 8 cwt. in a commercial bath with 0·005 per cent. heptachlor in August 1955 and subsequently grown on a holding in Cornwall where infestation was always severe was satisfactory, and only two of 200 bulbs were infested when they were lifted in July 1956. Since the period during which bulbs can be given hot-water treatment with heptachlor or chlordane without root injury is limited, it is unlikely that large quantities could be treated by this method without some risk.

Raw (F.) & Lofty (J. R.). **Estimating Crop Losses due to Wheat Bulb Fly.**—*Plant Path.* **6** no. 2 pp. 51–56, 1 pl., 2 graphs, 5 refs. London, 1957.

Losses of wheat due to infestation by the wheat bulb fly [*Hylemyia coarctata* (Fall.)] were evaluated in preliminary tests at Rothamsted in 1954–55. In the first, one strip in each of two pairs in fallow plots receiving different manurial treatments was screened with netting to prevent oviposition from the end of the first week in July until the end of September, and the plots were subsequently ploughed in October and sown with wheat on 6th December. Counts of the plants and shoots and of the number infested along a 6-in. length of drill were made in April 1955, when most plants receiving adequate nutrition had 2–3 tillers, and the yields of grain and straw were recorded at harvest. Up to 7 per cent. of the plants became infested in the screened strip, which was probably owing to the mechanical introduction of eggs during ploughing and cultivation, since none was found in samples of soil examined after the removal of the screens; in the unscreened strips, infestation ranged from 9·8 to 34·4 and the number of plants was reduced. There were no significant differences in the yields of grain and straw, and it is concluded that infestation of up to about 30 per cent. in a crop that has begun to tiller has no effect on yield.

In the other test, levels of infestation were varied by providing soil conditions known to influence oviposition, which had been shown to be favoured by a rough tilth and cultivation during the oviposition period but not affected by dressings of farmyard manure. Egg counts were made in the experimental plots in September 1954, wheat was sown on 7th December, and infestation was recorded in April 1955, when the plants were beginning to tiller, and yields of grain and straw at harvest. On the plots dressed with farmyard manure while fallow, the number of eggs per sq. ft. and (in brackets) the percentage of plants infested ranged from 39 (46) on the one with smooth tilth that was not cultivated during the oviposition period to 96 (66) on the one with rough tilth that was, and on the plots without manure, they ranged correspondingly from 38 (37) to 89 (81). Yields of grain ranged from 38·5 to 34·1 cwt. per acre on plots with farmyard manure

and from 36·7 to 30·5 on those without, and a similar trend was observed in the yield of straw. Grain yields were significantly and negatively correlated with egg populations and, in the plots dressed with farmyard manure, with plant infestation.

Zwölfer (H.). **Zur Kenntnis der Parasiten des Tannentriebwicklers** *Choristoneura* (*Cacoccia*) *murinana* **Hb. Teil I.** [Investigations on the Parasites of *C. murinana*. Part I.]—*Z. angew. Ent.* **39** pt. 4 pp. 387–409, 5 figs., 10 refs. Berlin, 1956. (With a Summary in English.)

Investigations were resumed in 1955 in the Vosges Mountains of France on the parasites of *Choristoneura murinana* (Hb.) on silver fir [*Abies alba*] with a view to finding species suitable for despatch to Canada for trial against *C. fumiferana* (Clem.) on spruce and balsam fir [*A. balsamea*]. The results are recorded in detail and compared with those obtained in the same district in 1947–48 [*R.A.E.*, A **43** 172] and in similar investigations elsewhere [**24** 340; **35** 72], and a list is given of all the parasites reared from *C. murinana*, showing the regions in which they were observed. In 1955, when 70–80 per cent. of the May shoots had been destroyed in some places, though damage was generally less than in 1947–48, fifth- and sixth-instar larvae and pupae were collected near Ribeauville between 7th and 26th June and reared in the laboratory. In all, 23 species of parasites emerged, of which seven were not previously known to attack *C. murinana*. Of the larvae, 5–7 per cent. were parasitised on old trees and 2 per cent. on young ones, while about 2–4 per cent. were killed by virus diseases. Pupal parasitism was 29–55 per cent. on old trees, and again somewhat less on young ones, and mortality of both stages due to unknown causes in the laboratory was high.

Of the parasites of the larvae, *Glypta murinanae* Bauer [*cf.* **35** 72], together with another Ichneumonid of the same genus, possibly *G. cicatricosa* Ratz., comprised 85 per cent., and *Apanteles* sp. (near *A. dioryctriae* Wlkn.) 5 per cent., and of the parasites of the pupae, *Itoplectis maculator* (F.) [*cf.* **35** 73] comprised 34 per cent., *Phaogenes maculicornis* (Steph.) 49 per cent., *Pimpla turionellae* (L.) 5 per cent., *Triclistus globulipes* (Desvignes) 4 per cent., *Blaptocampus nigricornis* (Wesm.) and *Chorinaeus longicornis* Thoms. each 2 per cent., and *Agrypon varitarsum* (Wesm.) 1 per cent. *Phaeogenes maculicornis* was somewhat more numerous than *I. maculator* in old stands, but less so on young trees. Details of the seasonal occurrence of the more important parasites are shown in a diagram. Pupal parasitism began with *I. maculator*, which appeared about 10th June, and development lasted 20–24 days for *I. maculator* and *P. maculicornis*, 23–27 days for *Pimpla turionellae* and probably about the same or somewhat longer for the other pupal parasites. The beginning of the main emergence period coincided approximately with the end of that of *Choristoneura*, and males generally emerged before females. The two sexes of *Phaeogenes* and *Pimpla* were present in about equal numbers, but the ratio of males to females in *I. maculator* was 2·6 : 1, probably as a result of parthenogenetic reproduction following bad weather, which reduces pairing. Mortality was high in *Glypta* and *Apanteles*. It reached 25–30 per cent. in the former, and 5–10 per cent. was caused by hyperparasites, mostly *Monodontomerus aereus* Wlk. but occasionally *I. maculator*. Hyperparasites, chiefly *Hemiteles areator* (Panz.) and *H. albipalpus* Thoms., caused 40 per cent. mortality of *Apanteles*. In contrast, mortality of the pupal parasites was only 5–10 per cent. *Glypta* and *Apanteles* have only one generation a year, and this, together with their high mortality, renders them less effective parasites of *Choristoneura* than

are the pupal parasites, which have several generations a year, developing in alternative hosts, and attack *Choristoneura* at a stage in its development when other mortality factors have already exerted their maximum effect. They are, however, more influenced by abiotic factors. Comparison with the earlier investigations indicated that parasitism is more effective after an outbreak has begun to decline than while it is at its peak.

Rupp (H.). **Étude de l'action du diazinon dans la lutte contre les larves de** *Dacus oleae*.—*Mitt. schweiz. ent. Ges.* **29** pt. 3 pp. 233–253, 5 graphs, 8 refs. Berne, 1956. (With a Summary in English.)

In view of the good results given by diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] in preliminary tests on the control of *Dacus oleae* (Gmel.) on olive in Greece, further tests were carried out at Megara, near Athens, in 1955. Two proprietary emulsion concentrates of different strengths were used, and compared with a standard phosphorus compound known to give good control. The percentage of fruits infested was 48·6 on 8th September, when most of the larvae were in the first instar, and sprays containing 0·01–0·1 per cent. diazinon from both concentrates were applied on 15th–16th September by conventional apparatus. Oviposition continued in successive waves until about mid-November. Counts on 20th September showed that the lower concentrations (0·01–0·03 per cent. diazinon) had little effect except against larvae in the first instar, and many pupae and emergence holes were present; both diazinon and the product used as a standard appeared even to have accelerated development of the older larvae. The 0·1 per cent. sprays were the only ones effective against the second- and third-instar larvae. Further counts made on 12th October and 19th November showed that the deposits had retained their efficacy against the first-instar larvae very well, particularly those from the stronger of the two products tested. Toxicity seemed to result from ingestion rather than contact.

Since water is scarce in the olive groves, the stronger concentrate was also applied on 15th September in atomised sprays at concentrations of 0·045–0·45 per cent. diazinon and a much lower rate of liquid per tree. Even the highest concentration gave little control by 20th September, but sprays containing 0·09 per cent. diazinon or more showed considerable residual effect and those containing 0·225–0·45 per cent. were about as effective against first-instar larvae on 12th October and 19th November as the conventional spray at 0·1 per cent. The deposits in g. per tree were 2·8–4·5 for the atomised sprays and 7–10 for the conventional spray, so that the former are economical in insecticide as well as in water, and the low toxicity of diazinon to mammals (the acute toxic dose being 100–200 mg. per kg. body weight, and rats showing no effects after ingestion of 100–1,000 parts diazinon per million in their food for 91 weeks) renders them safe for use.

In a third test, the trees were sprayed once with 0·015–0·1 per cent. diazinon with knapsack apparatus on dates ranging at intervals of three days from 15th September to 7th October. The results were estimated on 12th October and 19th November, and showed little difference in residual effect with treatment date. The lowest concentration appeared less effective than in the first test, probably because of the larger droplet size of the spray, and there was little difference between the other three concentrations applied on any of the dates. The diazinon residues in fruits extracted on 29th November did not exceed 0·8 p.p.m., whereas the tolerance established for parathion in the United States is 1 p.p.m., and it is concluded that they present no problem if diazinon is applied at 0·03–0·04 per cent. twice, in the

second half of August and again six weeks later, 2–3 months before harvest, or at 0·08 per cent. once when the number of punctures per 100 fruits reaches 20–25.

WILLE (H.). *Bacillus fribourgensis*, **n.sp., Erreger einer "Milky Disease" im Engerling von** *Melolontha melolontha* **L.** [*B. fribourgensis*, the causal Agent of a Milky Disease in the Larva of *M. melolontha*.]—*Mitt. schweiz. ent. Ges.* **29** pt. 3 pp. 271–282, 3 figs., 12 refs. Berne, 1956.

Larvae of *Melolontha melolontha* (L.) showing symptoms of a milky disease were observed, apparently for the first time in Europe, in a locality in the canton of Fribourg, Switzerland, at the end of July 1955 and in another in the canton of Lucerne in the autumn. The proportion of larvae showing symptoms at either place in autumn was very low, but as infection was often masked and control measures had been applied, the actual proportion was probably much higher. Bacteria resembling *Bacillus popilliae* [*cf. R.A.E.*, A **35** 389] were isolated from the haemolymph of the larvae and are described as *B. fribourgensis*, sp.n. In tests on artificial infection, third-instar larvae that had moulted 4–5 weeks or three months previously, taken from the field at the end of July and in mid-October, respectively, and second-instar larvae that had moulted 6–7 weeks previously were used. Suspensions of the spores were injected into the haemolymph of third-instar larvae, each receiving 500,000 spores, after which the younger ones were kept at 20–25°C. [68–77°F.] and older ones at 18°C. [64·4°F.], and *per os* into second- and third-instar larvae, the former receiving 500,000 or 750,000 spores each and the latter one million, after which the younger third-instar larvae were kept at 20°C. and all the rest at 18°C. Other second- and third-instar larvae were confined in soil in receptacles, which had been treated with 75 million spores each, and kept at similar temperatures. Following intralymphal injection, the first larvae to show symptoms of infection by *B. fribourgensis* did so after 10 days, and the rest in the following 2–4 weeks. Similar results followed oral injection, but symptoms did not appear sooner than after three weeks in infected soil. The course of the disease was dependent on temperature, the numbers showing symptoms reaching a maximum after 20 days at 25°C. and after 28 days at 20°C. Never more than 20 per cent. of larvae in any test showed external symptoms of infection, but spores were present in large numbers in many more and the symptoms were frequently masked by those caused by other bacteria, rickettsiae and fungi (mostly *Beauveria* spp.) [*cf.* **46** 290] or a combination of these. The rickettsiae caused symptoms similar to those of Lorsch disease [*cf.* **44** 207] and appeared to be stimulated from a latent to an active state by infection of the larvae with *Bacillus fribourgensis*, their normal rate of development (50–80 days from the time of infection to the appearance of the first outward symptoms) being greatly increased. Mortality varied greatly in the individual tests. Calculation of averages showed that, of the larvae infected intralymphally, 49·6 per cent. died containing spores of *B. fribourgensis* and that a further 39·5 per cent. died without containing them, while 22·3 per cent. died in the controls, and maximum mortality was reached after 27–35, 25–35 and 27–29 days, respectively, at 20–25°C. and after 29–63, 21–64 and 35–61 days at 18°C. For larvae infected orally, the corresponding mortality percentages were 16, 62·1 and 34·1 and maximum mortality was reached after 15, 29 and 29 days, respectively, at 20°C. and after 39–57, 39–64 and 39–63 days at 18°C. For larvae kept in infected soil, the mortality percentages were 19·3, 51 and 24·4 and maximum mortality was reached after

39–72, 21–81 and 39–81 days, respectively. It is not yet known whether *B. fribourgensis*, like *B. popilliae*, retains its virulence for long in the soil, but spores remained virulent after pasteurisation for 10 minutes at 80°C. [176°F.].

Vogel (W.), Klingler (J.) & Wildbolz (T.). *Pamene rhediella* **Clerck, der Bodenseewickler, ein bisher übersehener Obstschädling.** [*Pammene rhediella*, a hitherto overlooked Fruit Pest.]—*Mitt. schweiz. ent. Ges.* **29** pt. 3 pp. 283–302, 10 figs., 15 refs. Berne, 1956.

In addition to *Cydia* (*Carpocapsa*) *pomonella* (L.), several other Tortricids infest the fruits of apple and pear in northern Switzerland. Many of them are of little importance, but some cause noticeable injury from time to time. One of these is *Pammene rhediella* (Cl.), infestation by which was high in 1955, reaching 70 per cent. on apple in one district cited, but lower in 1956. Observations on its bionomics showed that the larvae overwintered in cocoons beneath bark scales on the trunks and branches and pupated in early spring. The adults emerged in May, when apple is in flower, and the eggs were laid on the lower surfaces of the older leaves near blossom clusters. The larvae hatched in about a fortnight, infested the fruits from early June onwards and became full-fed in early July, after which they sought their winter quarters. One larva sometimes injured several fruits. Attack occurred principally at the point of contact of two fruits, though the larva sometimes spun a leaf to the fruit and attacked the latter from beneath it, but it also occurred at the calyx or stem-base. The fruits did not generally fall as a result of infestation, and some continued to grow and remained on the trees until harvest. Cherries were also attacked, again chiefly at points of contact. Parasites observed comprised *Atromctus geniculatus* (Hlmgr.) and a species of *Ephialtes*, probably *E. pictipes* (Grav.), which were reared from the pupae and the larvae, respectively. When sprays containing diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate], parathion or malathion in wettable powders were applied to apple trees on 4th June and infestation was estimated on 2nd July, complete control was given by the first two materials, but malathion proved inferior. In another test, sprays containing wettable parathion were applied on 23rd May or 8th June, and control was complete in each case on 3rd July. Characters by which the larvae of *P. rhediella* can be distinguished from those of other apple pests are described in some detail, and a diagram is given illustrating differences between the life-cycle of *Pammene* and those of *C. pomonella* and *C.* (*Laspeyresia*) *janthinana* (Dup.), which also infests apple in northern Switzerland. *C. janthinana* apparently has only one generation a year, coinciding with the first generation of *C. pomonella*, and is usually controlled by the sprays applied against the latter. The various stages of both are present about a month later than those of *P. rhediella*.

Pschorn-Walcher (H.). *Aphanogmus nigrofornicatus* **nov. spec. (Proctotrupoidea, Ceraphronidae), ein Parasit der räuberisch an Adelgiden lebenden Gallmückenlarven von** *Aphidoletes thompsoni* **Moehn.** [*Aphanogmus nigrofornicatus*, sp.n., a Parasite of the Larvae of the Cecidomyiid, *Aphidoletes thompsoni*, predacious on *Chermes* spp.]—*Mitt. schweiz. ent. Ges.* **29** pt. 4 pp. 353–362, 3 figs., 12 refs. Berne, 1956. (With a Summary in English.)

Descriptions are given of the adults of both sexes, eggs and larvae of *Aphanogmus nigrofornicatus*, sp.n., which was found in Switzerland in

1954–55 parasitising the larvae of *Aphidoletes thompsoni* Möhn, one of the predators of *Chermes* (*Dreyfusia*) spp. on silver fir [*Abies alba*] [*cf. R.A.E.*, A **46** 247]. It is an endoparasite, and, like its host, has two generations a year. The adults emerge in May–June, and the females oviposit in third-instar larvae of *Aphidoletes*. The larvae feed mainly in hosts that have reached the late prepupal stage, in which they enter the soil for pupation, and the adults emerge mostly in August–September. Development of the second generation proceeds to the second larval instar before winter and is resumed in spring, after hibernation in the host prepupae in the upper layers of the soil. Both host and parasite are commonest in autumn, and superparasitism occurs, though more than two adults are seldom produced per host. Parasitism of *Aphidoletes* averaged about 80 per cent. in the autumn of 1954, but only about 20 per cent. in 1955, as a result of a decrease in the population of *C.* (*D.*) *piceae* Ratz. and its predators in that year.

Bovey (R.). **Une anomalie des fleurs du trèfle causée par un virus transmis par des cicadelles.**—*Rev. rom. Agric.* **13** no. 12 pp. 106–108, 3 figs., 4 refs. Lausanne, 1957.

A disease of white clover (*Trifolium repens*) involving anomalies of the flowers or phyllody is common in French Switzerland and also occurrs in the Ticino. The symptoms, which are described, resemble those recorded by Frazier & Posnette as resulting from the transmission of the strawberry green-petal virus to clover by Cicadellids [*cf. R.A.E.*, A **46** 145–146]. In June 1957, some 50 examples of *Euscelis plebeja* (Fall.), the commonest Cicadellid present, were collected in a field of diseased clover and caged on healthy white-clover plants, on which they were left for ten days. Four weeks after the insects had been placed on them, these showed typical symptoms of the disease. *E. plebeja* is common in the region, in meadows, pastures and uncultivated areas, and has several generations a year. In further experiments, *Aphrodes bicinctus* (Schr.) also proved to be a vector, but it is less common than *E. plebeja*. The disease is of little importance in hay crops, but reduces seed yields, since infected plants are sterile.

Pradhan (S.), Jotwani (M. G.) & Rai (B. K.). **Bio-assay of Insecticides. VI. Comparative Toxicity of modern Insecticides to *Drosicha mangiferae* Green (Coccidae: Hemiptera).**—*Indian J. Ent.* **18** (1956) pt. 4 pp. 315–317, 7 refs. New Delhi, 1957.

In this sixth part of a series [*cf. R.A.E.*, A **45** 394, etc.], the results are given of laboratory tests of the toxicity of various organic insecticides to nymphs of *Drosicha stebbingi* (Green) (*mangiferae* Green), collected on mango in Delhi. Technical grades of insecticide were dissolved in benzene, and this was emulsified with Triton X-155 and diluted to the required concentration with water. Sprays were applied directly to the insects in petri dishes and mortality counts were made 72 hours later. Comparison of the LC50's showed that chlordane, dieldrin, isodrin, aldrin, lindane [almost pure γ BHC], endrin and malathion were 0·169, 0·205, 0·271, 0·339, 0·376, 0·749 and 11·882 times as toxic as p,p′DDT. In similar tests with commercial formulations, nicotine sulphate, parathion, Systox [diethyl 2-(ethylthio)ethyl phosphorothioate (demeton)] and diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] were about 0·1, 36, 6 and 3 times as toxic as p,p′DDT.

Chatterjee (S.). **Comparative Effect of airtight and ventilated Conditions of Storage on certain Pests of Wheat and 'Jowar' at different Levels of initial Moisture Content.**—*Indian J. Ent.* **18** (1956) pt. 4 pp. 318–331, 8 refs. New Delhi, 1957.

In the experiments recorded, samples of 200 g. cleaned wheat or sorghum with moisture contents of 5, 8 or 12 per cent. were placed in 1 lb. glass jars, covered with screw tops or wire gauze, and artificially infested with batches of 50 insects of selected species. After storage for five months at laboratory conditions, wheat infested with *Rhizopertha dominica* (F.) showed the greatest percentage of infested grains at the highest and the least at the lowest initial moisture content, whereas that infested with *Sitotroga cerealella* (Ol.) was equally damaged at all moisture contents. Wheat infested with *Calandra oryzae* (L.) and sorghum infested with *R. dominica*, *C. oryzae* or *Corcyra cephalonica* (Stnt.) showed most damage at 12 per cent. moisture, with no significant difference between the other two levels. Wheat was more severely damaged by *R. dominica* in ventilated than in airtight jars, but there were no other significant differences between the two methods of storage.

Wheat infested with *R. dominica* lost less and wheat infested with *Calandra oryzae* and *S. cerealella* and sorghum infested with *R. dominica* lost more weight in ventilated than in airtight jars; the other samples showed no significant differences. Wheat infested with *R. dominica* and *C. oryzae* lost most weight at 8 and 12 per cent. moisture content, respectively, and least at 5 per cent., whereas wheat infested with *S. cerealella* lost less at 8 per cent. than at the other levels and sorghum infested with any of the insects lost more at 12 per cent. than at the others; no other differences were significant.

It is concluded that insect damage is most likely to occur at the highest of the moisture contents tested and that the initial moisture content primarily determines the extent of damage under airtight conditions.

Mookherjee (P. B.) & Wadhi (S. R.). **Further Studies on the Phytotoxicity of modern organic Insecticides.**—*Indian J. Ent.* **18** (1956) pt. 4 pp. 332–335, 1 ref. New Delhi, 1957.

Investigations were carried out at New Delhi in 1953–54 on the toxicity of emulsion sprays of some of the newer organic insecticides to various crop plants, including cauliflower, castor [*Ricinus*], tomato, egg-plant (*Solanum melongena*) and peppers (*Capsicum*) and also several cucurbits, which are particularly sensitive to chemicals. Monthly averages of temperature and humidity were recorded, so that the results could be correlated with meteorological conditions. It was found that lindane [almost pure γ BHC] at concentrations of 0·25–1 per cent., dieldrin at 0·125–0·5 per cent. and aldrin at 0·25–0·5 per cent. caused no damage to any of the plants, and DDT, tested at 0·25–2 per cent., and toxaphene at 0·25–1 per cent. none except to cucurbits, which were slightly or seriously damaged by concentrations of 0·5–1 per cent. in September–October. Dieldrin and toxaphene were applied to maize in April; both caused slight damage at 0·25 per cent., and toxaphene severe damage at 0·5 per cent.

Bhatia (D. R.) & Gupta (D. S.). **Some new Roles of Birds in Locust Control.**—*Indian J. Ent.* **18** (1956) pt. 4 pp. 340–348, 4 figs., 7 refs. New Delhi, 1957.

The authors point out that birds, in addition to destroying locusts directly, also assist indirectly in their control. In the Indian desert, which consists

of sand dunes 50–300 ft. high and is largely covered by bush vegetation, concentrations of flying birds generally indicate the presence of a locust infestation or of the water needed for the preparation of sprays, and thus facilitate the work of anti-locust campaigns. Predacious birds also have the effect of causing locusts to congregate in bushes or trees in the daytime instead of spreading out over large areas on the march or flying in swarms, and so make control by spraying or dusting easy and economical. Such a concentration of *Schistocerca gregaria* (Forsk.) in *Prosopis juliflora*, which is not usually fed on, is described.

Patel (G. A.) & Bagal (S. R.). **Brood Studies of the Sugarcane Top-borer (*Scirpophaga nivella* Fab.).**—*Indian J. Ent.* **18** (1956) pt. 4 pp. 389–396, 6 graphs, 7 refs. New Delhi, 1957.

As experiments on the control of *Scirpophaga nivella* (F.) on sugar-cane in Bombay State by means of insecticides have been unsuccessful, the number of generations in the year and presumed times of maximum emergence of the moths were investigated in 1950–54, as a guide to the timing of applications. Affected shoots are regularly removed as a control measure on most estates in the Deccan canal area, and about 200 of these were examined each day for several days a month and the numbers of larvae, pupae and empty shoots noted. The percentages of insects that were in the pupal stage are shown for each month in graphs, with the mean monthly temperatures and relative humidities, and it is concluded from the results that there are up to five peak periods of pupation, and therefore of subsequent moth emergence in the year, occurring in October and February in plant cane and in April, June and August in ratoon cane. The peaks in October and April were not always evident and were hardly perceptible in a graph of the average data for the five years. The moths had emerged from averages of 48·9–76·3 per cent. of the shoots received each month, indicating that removal as at present practised is relatively ineffective as a method of control.

Majumder (S. K.), Muthu (M.) & Pingale (S. V.). **Bacterial Control of Insects. I. Studies on the Field Control of the Lablab Pod-boring Caterpillar.**—*Indian J. Ent.* **18** (1956) pt. 4 pp. 397–407, 4 figs., 18 refs. New Delhi, 1957.

A strain (HB-III) of *Bacillus thuringiensis* was isolated in 1955 from dying pod-borer larvae found on *Dolichos lablab* in Mysore, and an account is given of laboratory and field tests carried out on its effect on the larvae and its possible use for control. It is stated in an editorial footnote that the larvae were identified by the authors as *Heliothis armigera* (Hb.) (*obsoleta*, auct.), but that the photographs included in the present paper suggest that they were those of *Adisura atkinsoni* Moore. Infection had first been observed in the field in 1953–54, when it reached 22 per cent., but it was only 2 and 1 per cent., respectively, in the next two years.

When larvae, 15–18 days old, were confined for 24 hours in petri dishes on pods of *D. lablab* that had been sprayed with suspensions of the spores and were examined 24 hours after being transferred to unsprayed pods, complete mortality was found to have been given by doses of 3,000–5,000 spores per sq. inch. The pathogen declined in virulence when cultured on an artificial medium, but was restored to its original potency when re-isolated from larvae infected with it in the laboratory. The symptoms of the disease

caused are described. In tests with plants in pots, 80 healthy larvae caged on eight plants that had been sprayed with 3,000–5,000 spores or vegetative cells per sq. inch 24 hours before were all dead in eight days, as were 50–80 per cent. of 40 confined with equal numbers of diseased larvae on four untreated plants.

In field tests, spraying heavily infested plants in 1954–55 with 3,000–5,000 vegetative cells per sq. inch reduced infestation by about 50 per cent. or more in seven days and resulted in complete or almost complete mortality of larvae collected at random at that time and observed after another six days. Infestation was also somewhat reduced in adjacent untreated plots; about 35–40 per cent. of larvae collected from them showed symptoms of the disease, and about 25–35 per cent. died in six days. Releasing infected larvae on infested plants was much less effective. In 1955–56, spraying the plants with spore suspensions reduced infestation by over 95 per cent. in a week.

Pruthi (H. S.). **Critical Studies on Insecticides. II. Toxicity of Malathion under different Conditions of Temperature and Humidity.**—*Indian J. Ent.* **18** (1956) pt. 4 pp. 408–426, 29 refs. New Delhi, 1957.

This second paper of a series [*cf. R.A.E.*, A **46** 162] contains the results of tests of malathion against *Chrotogonus trachypterus* (Blanch.), a grasshopper that feeds on cotton and other crops in India; they were carried out in the laboratory in 1956 by the same methods as before. Tests under various conditions of temperature and relative humidity showed that low dosages of malathion gave rapid kill by contact action. Wettable-powder suspensions and emulsions containing 0·125 and 0·1 per cent. malathion, respectively, and a 5 per cent. dust, applied at 0·1 g. per ½-litre jar, usually gave complete kill in 30–90 minutes. Action as a stomach insecticide was slower, the same doses applied to the food alone sometimes taking several hours to kill the grasshoppers. Slight rises in temperature and large increases in humidity accelerated and increased mortality.

Rao (D.) & Prasad (S. N.). **A new Record of** *Lasioderma serricorne* **Fab. (Cigarette Beetle) breeding on stored Seed of** *Striga* **spp.**—*Indian J. Ent.* **18** (1956) pt. 4 pp. 459–460, 2 figs., 6 refs. New Delhi, 1957.

In May 1952, *Lasioderma serricorne* (F.) was found damaging stored seeds of *Striga lutea*, *S. densiflora* and *Centranthera nepalensis*, which are parasitic on the roots of cereal crops in India. The eggs were laid on the seeds, and the larvae fed on the seeds and pupated in cocoons formed in clusters. Populations were highest during August, when *Striga* produces abundant seeds, and it is considered that if the Anobiid were released in the field, it might control the root parasites by destroying the seeds in the pods.

Khan (M. Q.). **Cotton Semilooper,** *Anomis flava* **(Fb.) in Hyderabad State.**—*Indian J. Ent.* **18** (1956) pt. 4 pp. 461–462, 5 refs. New Delhi, 1957.

Cosmophila (*Anomis*) *flava* (F.) injured cotton over a large area in Hyderabad State in September 1956. The larvae devoured whole leaves, attacked the corolla, ovaries and stamens of the flowers and completely destroyed the calyces of developing bolls. Infestation by 25–30 larvae per

plant destroyed all but the main stem and branches, and populations of 5–6 sometimes damaged 20–25 per cent. of the flowers. The bolls themselves were not attacked, but sometimes withered owing to the loss of foliage. The eggs were deposited on the leaves, and pupation took place in cocoons spun between leaf folds; the egg, larval and pupal stages lasted about 3–4, 15–20 and 9 days, respectively. Mild outbreaks were controlled by hand-picking; against severe ones, spraying with 1–1·25 oz. lead arsenate per gal. or 0·25 per cent. DDT was ineffective, but a spray of endrin at 5 cc. 19·5 per cent. emulsion concentrate per gal. gave complete mortality within six hours when applied at 1·5–2 lb. toxicant per acre, provided that no rain fell.

Bindra (O. S.) & Kittur (S. U.). *Mermis* **sp. (Nematoda) parasitising Caterpillars of** *Amsacta moorei* **Butler.**—*Indian J. Ent.* **18** (1956) pt. 4 pp. 462–463, 1 ref. New Delhi, 1957.

Larvae of *Amsacta moorei* (Btlr.), especially of form *sara* (Swinh.), have caused serious losses of maize, *Pennisetum typhoides* and pulses in recent years in some districts of Madhya Pradesh. In 1956, they were found to be parasitised by *Mermis indica*. The percentage attacked varied from eight on light soils to 66 on heavy ones, and there were generally 1–2 Mermithids in a larva, though up to 23 were recorded. One emerged from an adult male of *A. moorei*, form *sara*, and one from a larva of *Cirphis* sp. on maize. The application of insecticides against *Amsacta* appeared to hamper the development of *M. indica*.

Usman (S.). **Some Field Parasites of the Potato Tuber Moth,** *Gnorimoschema operculella* **Zell., in Mysore.**—*Indian J. Ent.* **18** (1956) pt. 4 pp. 463–468, 10 refs. New Delhi, 1957.

Gnorimoschema operculella (Zell.) completes two generations between July and September on potatoes in Mysore; it also attacks the stored tubers. Although it has been present in India since about 1900, the only record of a parasite attacking it in the field there was doubtful [*cf. R.A.E.*, A **28** 512], and *Bracon gelechiae* Ashm. was therefore introduced against it from the United States in 1944–45 [*cf.* **37** 29]. In 1955–56, *Chelonus* (*Neochelonella*) sp. near *curvimaculatus* Cam., *Angitia* (*Dioctes*) sp., an Ichneumonid identified as *Campoplex* sp., an unidentified Ichneumonid and a nematode of the genus *Hexamermis* were reared from larvae found mining the leaves in the Bangalore District. In 1955, 15 and 20 per cent. of the larvae examined at Chickballapur in August and September, respectively, presumably belonging to the first and second generations, were parasitised by *Chelonus*, *Angitia* and *Hexamermis*, of which the first was by far the most abundant. At Hebbal in 1956, *Chelonus* and *Angitia* were reared in smaller numbers, with a few of *Campoplex* sp. and a single example of the other Ichneumonid.

Observations showed that the eggs of *Chelonus* are laid, usually singly, in the eggs of the host. The parasite larva fed in the host larva, which it left when the latter was almost full-fed, and spun a cocoon in the leaf-mine or in the soil. Only one parasite larva was observed per dissected host. Males and females occurred in about equal numbers and lived for 7–19 days. At temperatures of 67–83°F. in the laboratory, the period spent in the host lasted 18–23 days and the combined prepupal and pupal stages 8–9 days. The life-cycle of the parasite appeared to be fully synchronised with that of

G. operculella, but an alternative host is presumably utilised between crops, when the moth is present in the stored tubers and cannot be reached by the parasite.

Angitia, a solitary internal parasite, was moderately abundant in both generations of *G. operculella*; the eggs were deposited in the full-grown larvae, and the combined egg and larval stages and prepupal and pupal stages averaged about 12 and 7 days, respectively. The larvae left their hosts when full-fed and pupated in cocoons. The adults lived for about 13 days, and there were two generations between June and September. *Campoplex* sp. attacked half-grown larvae and left its hosts before pupating. At temperatures of 64–82°F., two adults emerged 41 and 43 days after the eggs were deposited. *Hexamermis* was most numerous after rain, but its life-history was not known.

Murthy (D. V.). **Effect of varying the sowing Date on the Incidence of *Enarmonia pseudonectis* Meyr. on the Sann-hemp Crop.**—*Indian J. Ent.* **18** (1956) pt. 4 pp. 468–469, 1 ref. New Delhi, 1957.

Crotalaria juncea, which is the commonest of the plants grown for green manure in the perennial irrigation zone in the Nizamabad District of Hyderabad, is infested by *Utetheisa pulchella* (L.) and *Cydia* (*Enarmonia*) *pseudonectis* (Meyr.). The former can be controlled in its early stages with insecticides, but the latter is an internal feeder and cannot. It is most injurious in September and October [*cf. R.A.E.*, A **46** 161], and counts in 1956 of the numbers of galls made by the time the crop was ploughed in showed that there were none on plants sown on 1st or 14th May and 1·5, 12·5 and 20 per sq. yard of plot on those sown on 1st and 16th June and 1st July, respectively. Some of the plants sown in May or early June were attacked by Noctuid larvae.

Ramchandra Rao (Y.). *Dacus dorsalis* **Hend. in Banana Fruits at Bangalore.**—*Indian J. Ent.* **18** (1956) pt. 4 pp. 471–472. New Delhi, 1957.

Larvae found tunnelling in the pulp of banana fruits bought in Bangalore in August–September 1955 gave rise to adults that were identified as *Dacus dorsalis* Hend. Bananas are not usually attacked by fruit-flies in South India.

Yushima (T.) & Tomisawa (J.). **Problems on Insect Resistance of Rice Plant to Rice Stem Maggot, *Chlorops oryzae* Matsumura. I. A new Method for measuring varietal Resistance of Crops against Rice Stem Maggot.**—*Jap. J. appl. Ent. Zool.* **1** no. 3 pp. 180–185, 3 graphs, 3 refs. Tokyo, 1957. (With a Summary in Japanese.)

Chlorops oryzae Mats. has increased in importance in recent years as a pest of rice in Japan. It is present from Hokkaido to Kyushu, and has two generations a year in Hokkaido and north-eastern Honshu and three elsewhere. Where there are three generations a year, the first develops on seedling rice, the larvae puncturing the leaf blades, and the second on rice in the field, damaging the ears. The larvae are concealed and therefore difficult to control, and the development of resistant varieties of rice is important. Resistance is usually measured by the percentage of injured

ears and punctured leaves [*cf. R.A.E.*, A **39** 300], but this is not entirely satisfactory, and a method was therefore developed whereby larvae reared from eggs laid by field-collected adults are placed on the uppermost leaves of test plants having 4–5 leaves. The larvae bore into the leaf sheaths in a few minutes and are observed for mortality during the first two instars; this gives a measure of resistance.

Gokan (N.), Yamanaka (H.) & Fujita (S.). **Studies on Bionomics and Control of the Almond Moth, *Ephestia cautella* Walker. I. The Effect of reduced Air Pressure on Hatching.** [*In Japanese.*]—*Jap. J. appl. Ent. Zool.* **1** no. 3 pp. 209–212, 6 graphs, 5 refs. Tokyo, 1957. (With a Summary in English.)

In the experiments described, batches of 20 eggs of *Ephestia cautella* (Wlk.) were placed with 0·25 g. milk cocoa powder in test-tubes and kept at an atmospheric pressure of 190, 380 or 760 mm. mercury for 1–23 days, after which all were kept at normal pressure and observed for hatching. A pressure of 380 mm. reduced the hatching rate significantly, with no differences between periods of exposure, whereas a pressure of 190 mm. resulted in differences for exposure period, no eggs hatching after exposure for 5 days or more.

Masaki (S.). **The local Variation in the Diapause Pattern of the Cabbage Moth, *Barathra brassicae* Linné, with particular Reference to the aestival Diapause (Lepidoptera: Noctuidae).**—*Bull. Fac. Agric. Mie Univ.* no. 13 pp. 29–46, 9 figs., 28 refs. Tsu, 1956.

The following is based on the author's summary. *Mamestra* (*Barathra*) *brassicae* (L.) infests cruciferous vegetables throughout Japan and has two generations a year both in the north (Hokkaido) and further south, in spite of differences in temperature and length of growing season. Although emergence of adults from overwintered pupae occurs later in Sapporo (Hokkaido) than in southern Honshu, the first-generation adults emerge a month earlier. In investigations on this phenomenon, egg batches from various localities were reared under constant conditions in the laboratory, and observations made on the occurrence of the pupal diapause. When rearing was carried out under a long photoperiod of 16 hours, larvae of populations from Hokkaido gave rise to non-diapause pupae, whereas pupae originating from Honshu and more southerly areas mostly entered a summer diapause. The duration of this diapause at 26°C. [78·8°F.] varied considerably among individuals and batches, but the mean tended to increase from north to south. Both the incidence and the duration of the diapause seemed to be determined by the genetic constitution of the populations and external conditions, and the characteristics of local populations were preserved under constant conditions of light and temperature for at least 2–3 successive generations. The diapause thus accounts for the delayed emergence of the first generation in southern Japan. Rearing under a short photoperiod of 12 hours caused long-term or winter diapause in all populations, but its intensity varied with local populations. Summer diapause is distinct from winter diapause not only in the conditions that induce it, but also in the temperature range required for its completion [*cf. R.A.E.*, A **46** 363], and low temperatures seem to avert it. The ecological significance of inherited variation in the diapause pattern is discussed, and the existence of similar variations in European populations of the moth suggested.

Bergman (B. H. H.). **Het mozaiek I en de heksenbezemziekte van de aardnoot** (*Arachis hypogaea* **L.**) **in West-Java en hun vector, de jasside** *Orosius argentatus* (**Evans**). [Mosaic I and Witches' Broom Disease of Groundnuts in West Java and their Cicadellid Vector, *O. argentatus*.]—*Tijdschr. PlZiekt.* **62** pt. 6 pp. 291–304, 2 pls., 1 graph, 14 refs. Wageningen, 1956. (With a Summary in English.)

T. H. Thung, in 1947, described the virus diseases that affect groundnuts in Java as witches' broom and three types of mosaic, and reported the results of preliminary tests of insect transmission. Mosaic I and witches' broom appear to be the commonest viruses in groundnuts near Bogor, and the author describes their symptoms (and those of Thung's mosaic II, which is possibly not a virus disease) and gives the results of further investigations on their insect vectors. Mosaic I was readily and witches' broom occasionally transmitted by *Orosius argentatus* (Evans), and neither by other Cicadellids, *Aphis craccivora* Koch (the vector of groundnut rosette in Africa) or other insects. The mosaic virus proved to be of the persistent type. The latent period in the insect lasted at least 8 days, and infection was retained for up to 77 days.

O. argentatus lays its eggs mostly in the petioles and stems of the plants. The number laid is about 200 per female, and the egg and nymphal stages last 9–10 and 14–16 days, respectively. Both nymphs and adults are very active, and feed on the lower surfaces of the leaves and on the petioles and stems, puncturing the phloem tissue of the vascular bundles. The puncture is invisible since no necrosis results. In laboratory tests, *O. argentatus* developed on various leguminous plants, on some of which it also occurs in the field, and on egg-plant (*Solanum melongena*), and the adults survived for some days on plants of still other species. The population densities of *O. argentatus* and two other Cicadellids common on groundnuts, *Erythroneura tripunctula* (Melich.) and *Empoasca sundaica* Bergman [*cf. R.A.E.*, A **45** 87], were estimated by sweeping at intervals for 15 months, from June 1953 to August 1954. *O. argentatus* was at no time very numerous during that period, and its numbers fluctuated less widely than did those of the other species, possibly owing to its lesser dependence on new growth, though they were generally lower in the rainiest months. Both the other species were parasitised by Dryinids [*cf.* **45** 145], but no parasites of *Orosius* were noted. In insecticide tests, a spray of 0·1 per cent. DDT applied once a week gave good control of the Cicadellids and reduced the spread of the mosaic virus, but BHC had no effect.

Uhmann (E.). **Die ersten Stände von** *Oncocephala tuberculata* **Olivier.** [The First Stages of *O. tuberculata*.]—*Philipp. J. Sci.* **85** (1956) no. 4 pp. 499–505, 1 pl. Manila, 1957.

Tjoa Tjien Mo. **Notes on** *Oncocephala tuberculata* (**Olivier**) (**Coleoptera: Hispidae**). **A Leafminer of Sweet Potato** (*Ipomoea batatas* **Poir.**) **in West Java.**—*T. c.* pp. 517–519, 5 refs.

The first of these papers contains descriptions of the immature stages of *Oncocephala tuberculata* (Ol.). In the second, it is stated that this Hispid, which is known only from India [*cf. R.A.E.*, A **29** 270] and West Java, proved unusually injurious to sweet potato near Bogor in 1953. The adults feed on the leaf epidermis. The eggs are laid in the upper surfaces of undamaged leaves, and the larvae mine in the latter, sometimes attacking more than one each, and pupate in sacs on either surface. The durations of the egg, larval, prepupal and pupal stages averaged 8, 16, 4 and 6 days.

respectively, and broad-leaved varieties were preferred. Parasites reared from the pupae comprised an undescribed Braconid of the genus *Stirobracon*, which afforded 4·8 per cent. parasitism, and the Eulophid, *Sympiesis femoralis* (Zhnt.), which was of little importance.

Passlow (T.). **Control of *Thrips tabaci* Lind. in Onion Crops in the Lockyer Valley.**—*Qd J. agric. Sci.* **14** no. 2 pp. 53–72, 1 fig., 11 refs.; also as *Bull. Div. Pl. Ind. Dep. Agric. Qd* no. 106, 20 pp., 1 fig., 11 refs. Brisbane, 1957.

The following is based largely on the author's summary. *Thrips tabaci* Lind. infests onions grown for consumption and for seed in the Lockyer Valley of south-eastern Queensland, to which part of the State the large-scale cultivation of these crops is practically confined. During 1951–55, an investigation of the economic importance of the thrips was made, and it included screening and field trials with 14 insecticides applied under irrigated conditions. Populations of the thrips were greatly reduced by several of the insecticides, including dieldrin, endrin, DDT and parathion in emulsion sprays and parathion as a dust, but parallel increases in yield were not consistently obtained. In irrigated plantings, the unthrifty plants, rather than the vigorous ones, became heavily infested, and are also more susceptible to damage. For the past decade, the dry-farming method of cultivation formerly practised in the Lockyer Valley has been replaced by irrigation, and this has reduced the economic importance of the thrips and the benefits that might otherwise have been derived from the use of insecticides.

Bengston (M.) & Winks (W. R.). **Studies of Arsenic Spray Residues on Apples.**—*Qd J. agric. Sci.* **14** no. 2 pp. 73–80, 2 graphs, 2 refs.; also as *Bull. Div. Pl. Ind. Dep. Agric. Qd* no. 104, 8 pp., 2 graphs, 2 refs. Brisbane, 1957.

The arsenic residues left on apples by lead-arsenate sprays were investigated during 1954–56 in a district of Queensland in which the use of this material against apple pests continues. In 1954–55, the residues of arsenic as arsenic trioxide on fruits from trees that were sprayed on 28th February with lead arsenate at 6 lb. per 100 gals., with or without the addition of 0·1 or 0·2 per cent. DDT, were sampled on four dates between 7th March and 12th April, and were found to be about 1·8 times as great as those on fruit from trees sprayed on the same date with lead arsenate at the recommended rate of 3 lb. per 100 gals.; on 12th April, they were only slightly below the permitted tolerance of 1·4 p.p.m. In 1955–56, the sprays were applied on 23rd–24th November and the lead-arsenate treatment was combined with or followed after 24 hours by a spray of 0·01 per cent. parathion with 0·1 per cent. DDT. The mean arsenic residues at harvest in early January left by lead arsenate at 3 and 6 lb. per 100 gals. were 0·58 and 1·46 p.p.m., respectively. No arsenic was found in the flesh of the fruit in either year. It is concluded that arsenical residues do not weather to any extent and that the gradual reduction per unit weight noted during the season is caused by fruit growth. On earlier varieties than that used, growth is comparatively rapid and a correspondingly greater residue reduction would occur before harvest. Applications of lead arsenate after late November would increase the risk of residues exceeding the tolerance.

Gay (F. J.), Greaves (T.), Holdaway (F. G.) & Wetherly (A. H.). **The Development and Use of Field Testing Techniques with Termites in Australia.**—*Bull. sci. industr. Res. Org. Aust.* no. 280, 31 pp., 3 pls., 7 figs., 17 refs. Melbourne, 1957.

Field work in Australia on the testing of preservatives and soil insecticides, for protecting wood from termites, and of timbers, for resistance to the insects, was begun in 1929. In this paper, the authors review the methods adopted, and the following is based on their summary of it.

In view of the inconsistent results given by the early " graveyard " tests, experiments were carried out to improve the technique of field testing. Most of the fundamental work was done with *Nasutitermes exitiosus* (Hill) and subsequently adapted for use with *Coptotermes lacteus* (Frogg.). Test samples installed in mounds of *N. exitiosus* and *C. lacteus* were frequently plastered over and not attacked by the termites. When they were installed in a ring round the mounds at various distances and spacings, attack was irregular. It was most uniform when a large number of samples was installed at a distance of 2 ft. from the edge of the mound, since the trench dug round it to facilitate installation ensured that the termites made greater contact with the samples when they re-established their broken galleries. The probability of contact was further increased by placing a continuous strip of susceptible timber in contact with all the test samples at a depth of 3–7 in. below ground level [*cf. R.A.E.*, A **26** 449]. This depth was determined from an analysis of the depths of initial contacts in a large number of field samples and was supported by gallery studies of the termites concerned. The general procedure adopted for carrying out field tests round mound colonies is described.

The connecting-strip method was successfully adapted for use with species that do not build mounds, including *Mastotermes darwiniensis* Frogg., *C. acinaciformis* (Frogg.) and *C. frenchi* Hill, for which the test samples were installed in a grid pattern and linked together by a connecting strip running along each row of samples and joining the ends of the rows. A further adaptation of the method was devised for testing wallboards and other materials liable to deterioration if embedded in the soil or exposed to the weather. These were tested in the form of closely fitting boxes on the above-ground portion of billets of timber arranged round mounds in the normal fashion. Each box-billet unit was protected by a weatherproof cover.

Methods for testing the effectiveness of soil treatments were developed for both mound-building and other termites. For mound colonies, a circular trench of known volume was divided into sectors, in which the soil was either treated or untreated. The effectiveness of treatments was determined by the ability or otherwise of the termites to attack billets of susceptible timber installed in each sector. A similar method was used for the species that do not build mounds, but the billets were installed in isolated units of treated or untreated soils randomly arranged in plots. Each plot had a grid of connecting strips round the perimeter and between each row of test units. Some typical results of field tests, using the various techniques described, are given for timbers, timber treatments, wallboards and soil treatments.

Gurr (L.). **A Note on the Occurrence of the Eucalyptus Tortoise Beetle (*Paropsis dilatata* Er.) in the North Island.**—*N.Z. J. Sci. Tech.* **38** (A) no. 8 p. 807, 4 refs. Wellington, N.Z., 1957.

Paropsis dilatata Erichs. was recorded from *Eucalyptus* at Bulls, in the south-west of the North Island of New Zealand, in 1925 [*R.A.E.*, A **19** 221],

but was later thought not to have become established. During the summer of 1956, larvae of this Chrysomelid damaged nursery stock and older trees of *Eucalyptus* at Bulls, and specimens were received from four widely separated localities in and about Palmerston North. In 1957, damage was frequent between these two places, and the Chrysomelid was also found in the autumn in an isolated county farther to the north-west. It is thought likely that the outbreak resulted from breeding by recently introduced beetles.

Wilkinson (A. T. S.). **Chemical Control of the European Wireworm *Agriotes obscurus* (L.) in the Lower Fraser Valley of British Columbia.** —*Canad. J. Pl. Sci.* **37** no. 4 pp. 413–417, 1 graph, 1 ref. Ottawa, 1957.

Agriotes obscurus (L.) was first reported in the Fraser Valley, British Columbia, in 1952 [*cf. R.A.E.*, A **43** 117]. A recent survey showed it to be confined to an area of less than 800 acres, but its presence constitutes a hazard, and its control by means of insecticides incorporated into the soil was investigated in 1953–56. The work was carried out in a field of silty loam in which in 1952 two plantings of maize had been destroyed and a stand of autumn-planted rye reduced by 65 per cent. as a result of infestation. The following is partly based on the author's summary of the results. Single applications of dusts of aldrin or heptachlor and an emulsion spray of aldrin, all applied to the surface of the soil at 5 lb. toxicant per acre and worked into it to a depth of 6 ins. by ploughing and disking, gave good protection to potatoes planted a month later and caused complete mortality of *A. obscurus* by the second or third season. Similar applications of an emulsion spray of aldrin and a dust of DDT at 2·5 and 15 lb. toxicant per acre, respectively, and heptachlor in granules applied, three days after planting, at 3 lb. toxicant per acre in bands along the rows and raked in to a depth of 2–3 ins. were not satisfactory in the year of application, but gave appreciable control in the third and fourth seasons. Ethylene dibromide applied during ploughing at 1·6 gal. per acre was not effective, though it has given complete control in light soil.

Morgan (C. V. G.) & Anderson (N. H.). **Some Aspects of a Ryania-Glyodin Spray Schedule in British Columbia Apple Orchards. I. Entomological, horticultural, and economic Aspects.**—*Canad. J. Pl. Sci.* **37** no. 4 pp. 423–433, 7 refs. Ottawa, 1957.

Porritt (S. W.). **II. Effect on Storage Quality of McIntosh, Delicious and Newtown Apples.**—*T. c.* pp. 434–439, 1 graph, 4 refs.

An account is given in the first part of this paper of comparative tests of the value against *Cydia* (*Carpocapsa*) *pomonella* (L.) of the standard schedule of DDT and of the ryania schedule found advantageous in Nova Scotia [*cf. R.A.E.*, A **45** 342] and West Virginia [**45** 186], made in apple orchards in the Okanagan Valley of British Columbia in 1954–55, and the following is based on the authors' summary of the results. Four applications of sprays containing ryania at 48 lb. per acre with glyodin [2-heptadecyl glyoxalidine acetate] as the fungicide gave control of light infestations of *C. pomonella* similar to that from four sprays of 50 per cent. DDT at 12 lb. per acre, with lime-sulphur, ferbam [ferric dimethyl dithiocarbamate] and wettable sulphur. In a heavily infested orchard, ryania was inferior to DDT. The ryania-glyodin schedule also controlled *Eriosoma lanigerum* (Hsm.) and *Aphis*

pomi Deg. and had little detrimental effect on predacious mites. Except for *Vasates schlechtendali* (Nal.), phytophagous mites were usually less troublesome where the modified schedule was used. Packing-house records for four varieties showed that the ryania-glyodin schedule reduced the size of the fruits and lowered the grade of three varieties, and reduced the size but improved the grade of the fourth. The use of the modified schedule in 1954 reduced the size of the crops in 1955 on all varieties; those of the two most seriously affected were reduced by 76·2 and 53·7 per cent.

Observations on the storage qualities of the treated apples, reported in the second part, showed that the keeping qualities of two of the varieties were adversely affected by treatment with ryania and glyodin, apparently through the harmful effects of the sprays on the growth and production of the trees.

Gardiner (L. M.). **Deterioration of Fire-killed Pine in Ontario and the causal Wood-boring Beetles.**—*Canad. Ent.* **89** no. 6 pp. 241–263, 15 figs., 21 refs. Ottawa, 1957.

The following is based partly on the author's summary. Notes are given on the bionomics of 17 Longicorns found during 1949–51 breeding in or at rest on pine trees in an area in northern Ontario that had been devastated by fire in the summer of 1948. A key to the larvae of these and three other species reported to breed in pines in Ontario is included. By far the most injurious were *Monochamus notatus* (Dru.), *M. scutellatus* (Say) and *M. mutator* Lec., of which the first two most frequently attacked white pine [*Pinus strobus*] and the last jack pine [*P. banksiana*]. Adults of these Lamiids were present from mid-June until early September and most active in late July, and complete development usually lasted two years, but was sometimes completed in one. The larval galleries penetrated more deeply into the wood than those of the other beetles, and reached an average maximum depth of 5–6 ins. in white pine (with a maximum of 9·5 ins.), 3–5 ins. in jack pine, and 2–4 ins. in red pine [*P. resinosa*]. The galleries reach their greatest depth at the end of the first season and are usually extended back to the surface during the second, so that maximum direct damage is normally complete at the end of 15 months.

Observations on the effects of fire on the trees showed that jack pine was the most and red pine the least susceptible. The extent of the injury affected the time and nature of the infestation by insects. Severely damaged trees died and became infested shortly after the fire, moderately damaged ones usually died during the first winter and became infested in the following spring, and lightly injured ones usually escaped infestation for at least a year and frequently survived. Infestation by *Monochamus* spp. was heaviest on trees that were killed outright or died quickly; those that died slowly during the summer or in the winter were attacked by shallow-boring species before the females of *Monochamus* became active. The latter appeared to oviposit only in wood that had attained a certain degree of dryness and was not heavily attacked by other species.

In planning salvage operations after summer fires affecting red and white pine, it is desirable to pay first attention to the more valuable white pine, since it is the more susceptible to attack by deep-boring species. Severely damaged trees should be felled first, moderately damaged ones can be left until the following summer, though they are best felled during the winter following the fire, and lightly damaged ones need not be felled for at least a year. It may be advantageous to retain the lightly damaged trees to produce seed for regeneration; in stands in northern Ontario in which this was done, most of the trees were still alive six years later, and reproduction of both red and white pines was more satisfactory than elsewhere.

Lyons (L. A.). **Insects affecting Seed Production in Red Pine. IV. Recognition and Extent of Damage to Cones.**—*Canad. Ent.* **89** no. 6 pp. 264–271, 1 fig., 4 refs. Ottawa, 1957.

This final part of a series on insects that reduce seed production in red pine (*Pinus resinosa*) in Ontario [*cf. R.A.E.*, A **46** 390, etc.] contains the results of investigations in 1950–54 on the time and duration of attack and the extent of the losses due to it, with keys for the recognition of the damage caused to the cones by the different species and for the separation of the full-grown larvae of the insects commonly found in them. Observations in 1953 on *Conophthorus resinosae* Hopk. [*cf.* **46** 129], *Dioryctria disclusa* Heinr. [*cf.* **46** 315], *Eucosma monitorana* Heinr. and *Cydia* (*Laspeyresia*) *toreuta* (Grote) [*cf.* **46** 390], the four species numerous enough to provide reliable data, confirmed previous findings that damage is almost entirely restricted to June–July and heaviest between mid-June and mid-July; where *D. abietella* (Schiff.) is also present, however, it continues until later in the summer [*cf.* **46** 315]. Insect damage is commonest during the second year of cone development and usually destroys the cones within a few weeks, though cones attacked by *Dioryctria* spp. and *Rübsaamenia* sp. sometimes recover. Its intensity fluctuated widely from year to year, varying inversely with cone production, and almost complete destruction of the crop in successive years was not unusual. The species composition at different localities remained fairly constant from year to year. *Conophthorus resinosae* was the most widespread and abundant and, in places, the only species present, but *D. abietella*, which was scarce during the first few years, was almost as common as *C. resinosae* in 1954. *D. disclusa* was virtually confined to one county, and *E. moritana* was abundant at only one place. A decrease in the number of cones or an increase in the insect population may result in competition between species, which is detrimental to some, if not all [*cf.* **46** 129]. A severe shortage of cones is likely to be most harmful to *Cydia toreuta*, which attacks only sound cones late in the season [*cf.* **46** 390].

Holmes (N. D.), Peterson (L. K.) & McGinnis (A. J.). **Differences in Survival of the Wheat Stem Sawfly, *Cephus cinctus* Nort. (Hymenoptera: Cephidae), from two geographic Areas in Varieties of Spring Wheat.**—*Canad. Ent.* **89** no. 6 pp. 272–275, 2 refs. Ottawa, 1957.

In previous work on the resistance of the Rescue variety of wheat to attack by *Cephus cinctus* Nort. [*R.A.E.*, A **37** 233], the percentages of stems cut by the larvae at Regina, Saskatchewan, and Lethbridge, Alberta, over a period of five years averaged 36 and two, respectively. The ability of the sawflies from these two places to infest and cut Rescue and other varieties of spring wheat was accordingly investigated at Lethbridge in 1949–53 and at Regina in 1952–53. Sawflies from the two places were introduced into or allowed to emerge in plots of wheat protected by plastic screen cages from natural infestation, and the following is based on the authors' summary of the results. The percentages of infested stems of Rescue wheat cut in the two localities did not differ significantly, and the difference previously observed must therefore have been due to environmental causes. However, the sawflies from Lethbridge cut a significantly higher percentage of infested stems of a resistant durum variety (Golden Ball) than did those from Regina, and this was apparently the result of genetic differences; larvae from Lethbridge became established and, in 1953, reached maturity in a higher percentage of the stems. There were no apparent differences in the degrees of infestation or cutting in two susceptible varieties.

Finnegan (R. J.). **Elm Bark Beetles in southwestern Ontario.**—*Canad. Ent.* **89** no. 6 pp. 275–280, 3 figs., 26 refs. Ottawa, 1957.

The author reviews the distribution of Dutch elm disease in Canada and of the two Scolytid vectors of the causal fungus (*Ceratostomella ulmi*) there and in the United States [*cf. R.A.E.*, A **46** 387], and describes observations on the seasonal history of the latter in south-western Ontario, carried out in 1954–55 to provide a basis for control operations. The introduced *Scolytus multistriatus* (Marsham), which is present in Canada only in south-western Ontario [*cf. loc. cit.*], has one generation a year and a partial second. Adults of the overwintered generation emerge in June and July and give rise to a generation of which most of the adults emerge in August or early September, feed in the crotches and bark for about a month and die without constructing brood galleries; a few oviposit, and the larvae thus produced, with the remaining first-generation larvae, subsequently overwinter. Peak attack by the adults occurs in late June and early July. The native *Hylastes* (*Hylurgopinus*) *rufipes* Eichh., which is stated to occur in widely separated localities in southern Ontario and southern Quebec and also near Fredericton, New Brunswick, also has one complete and one partial generation a year. In south-western Ontario, its seasonal history resembles that recorded for New England [*cf.* **28** 85] and Quebec; adult activity begins about two weeks earlier in Ontario, but the period of autumn feeding is longer. *S. multistriatus* is generally thought in the United States to be the more important vector, but since the disease spread very rapidly in Quebec, where *H. rufipes* is the only vector known, it is considered that the importance of *H. rufipes* has been under-estimated. The adults are active about a month earlier than those of *S. multistriatus*, which is important because transmission is confined almost completely to spring and early summer [*cf.* **29** 563].

Fox (C. J. S.). **Note on Occurrence in Cape Breton Island of *Tipula paludosa* Mg. (Diptera: Tipulidae).**—*Canad. Ent.* **89** no. 6 p. 288, 3 refs. Ottawa, 1957.

Adult Tipulids reared from larvae collected from flower beds in a locality in the west of Cape Breton Island were identified in September 1955 as *Tipula paludosa* Mg., which further surveys showed to be established in several other parts of the island. Apart from a doubtful record for Newfoundland, this injurious European species has not hitherto been recorded from North America, into which it was probably introduced with soil ballast [*cf. R.A.E.*, A **43** 117]. Invasion of old hay sod by *Hieracium* spp. following the destruction of the grass roots by the larvae, a condition similar to that associated elsewhere in Nova Scotia with heavy infestations of *Agriotes sputator* (L.) [*cf. loc. cit.*], occurred at one place. Good control of the larvae in lawns was given by aldrin sprays and by a bran bait containing paris green.

Parent (B.) & Beaulieu (A. A.). **Life-history of the European Red Mite.**—*Canad. Ent.* **89** no. 7 pp. 328–333, 2 graphs, 10 refs. Ottawa, 1957.

The following is based on the authors' summary of this account of studies in 1948–51 on the bionomics of *Panonychus* (*Metatetranychus*) *ulmi* (Koch) on apple in south-western Quebec, where this mite was first recorded causing

serious damage in 1945 and has since been of major importance. In the orchard, the overwintering eggs were laid on apple trees between mid-August and early October of each year and hatched in the following spring at about flowering time. In insectary experiments, in which the mites were reared on year-old grafted apple trees of two varieties grown in pots, most of the summer eggs were laid on the lower surfaces of the leaves, where the immature stages developed. The egg stage averaged 7–9 days and the rest of the development period 4–8 days. The preoviposition and oviposition periods occupied about 1½–2½ and 4–12 days, respectively, and the females of the first five generations laid averages of 10–35 eggs each. There were six generations each year, and a seventh in 1949. In 1948 and 1950, all stages but the adults of a seventh generation were recorded, and eggs of an eighth generation were produced in 1949.

Holmes (N. D.) & Peterson (L. K.). **Effect of continuous Rearing in Rescue Wheat on Survival of the Wheat Stem Sawfly, *Cephus cinctus* Nort. (Hymenoptera: Cephidae).**—*Canad. Ent.* **89** no. 8 pp. 363–364, 3 refs. Ottawa, 1957.

Although the Rescue variety of wheat, which is resistant to *Cephus cinctus* Nort., has been grown in Canada and the United States since 1946 and there is no evidence of the existence of a strain of the sawfly to which it is not resistant [*cf. R.A.E.*, A **40** 118], an experiment was carried out in Alberta to determine whether such a strain could be segregated by continuous rearing. Some 2,000 stubs containing larvae collected from Rescue wheat were placed in the spring of 1952 in a plot of the same variety, which was screened during the flight period, and the surviving progeny collected each autumn and stored until spring, when the procedure was repeated. By the autumn of 1955 there was only one survivor. In similar tests with two susceptible varieties, initial populations of 900 were reduced over the same period to 411 and 178, but the reduction in these was brought about largely by parasitism, which caused little mortality among the population in Rescue wheat. The effects of caging caused some reduction in all three plots. The resistance of Rescue wheat appears to depend upon the pithiness of its stems [*cf. R.A.E.*, A **43** 436], but this varies considerably. If most of the sawflies that survive in it do so only because they are in the less solid stems, a strain to which it is susceptible is unlikely to develop.

Maltais (J. B.) & Auclair (J. L.). **Factors in Resistance of Peas to the Pea Aphid, *Acyrthosiphon pisum* (Harr.) (Homoptera: Aphididae). I. The Sugar-Nitrogen Ratio.**—*Canad. Ent.* **89** no. 8 pp. 365–370, 14 refs. Ottawa, 1957.

An account is given of investigations in Quebec in which the contents of sugar and nitrogen in pea plants of three varieties that are resistant and three that are susceptible to infestation by *Macrosiphum* (*Acyrthosiphon*) *pisum* (Harris) were determined [*cf. R.A.E.*, A **39** 280]; the numbers of Aphids per plant sample found on them in the field over 13 years averaged 9·8–16·8 and 32·6–39·6, respectively. The results showed that the susceptible varieties contained more nitrogen and less sugar than the resistant ones, and the ratio of sugar to total nitrogen was 23·4–63·7 per cent. higher in the resistant than in the susceptible varieties. This suggests great differences in the nutrition of Aphids feeding on resistant and susceptible varieties.

Bird (F. T.) & Elgee (D. E.). **A Virus Disease and introduced Parasites as Factors controlling the European Spruce Sawfly, *Diprion hercyniac* (Htg.), in central New Brunswick.**—*Canad. Ent.* **89** no. 8 pp. 371–378, 3 graphs, 11 refs. Ottawa, 1957.

The outbreak of *Gilpinia* (*Diprion*) *hercyniac* (Htg.) on spruce in eastern Canada that began about 1930 pursued its course, in spite of the control afforded by introduced insect parasites, until 1938, when a polyhedral virus disease of the larvae appeared in New Brunswick. The disease spread throughout most of the infested area by 1942 and is considered to have been the major factor in the collapse of the outbreak [*cf. R.A.E.*, A **33** 398]. Studies on the sawfly population, parasitism and virus infection were continued on one plot in central New Brunswick during 1943–1954 by means of samples collected each year, usually at weekly intervals between 20th June and 1st October, by beating larvae from the trees and rearing them in the laboratory, and they were supplemented by data on sawfly density obtained by sampling the cocoon population by the third of Prebble's methods [**32** 233]. The population of *Gilpinia* remained low throughout the period except for a sudden increase that occurred in 1944 and was controlled by the disease in 1945 and another in 1952 that was controlled by insect parasites. The following is based largely on the authors' summary of their analysis of the results.

Very effective control was given by the disease when sawfly densities were high and by some of the parasites when they were low. *Dahlbominus fuscipennis* (Zett.) and *Exenterus claripennis* Thoms., which caused important mortality when the host population was high, were replaced after about 1941 by *Sturmia* (*Drino*) *bohemica* (Mesnil) and *E. vellicatus* Cushm. [*cf.* **41** 57; **43** 171], and these appear to have been chiefly responsible for preventing the sawfly from increasing above the subsequent very low level. Until 1951, the effectiveness of the disease appeared to be dependent on the density of the sawfly and independent of stress factors such as weather, overcrowding and lack of food, and the susceptibility of the sawfly appeared to be so great that, if any increase in susceptibility was caused by stress factors, it was so small as to remain undetected. The increase in sawfly numbers in 1952 was not followed by increased mortality due to the disease, and this was the first indication of the possible development of resistance to it. However, since *D. bohemica* and *E. vellicatus* increased, especially in 1953, and sawfly numbers were again low in 1954, there appears to be little danger of a renewed outbreak.

Green (G. W.), Baldwin (W. F.) & Sullivan (C. R.). **The Use of radioactive Cobalt in Studies of the Dispersal of Adult Females of the European Pine Shoot Moth, *Rhyacionia buoliana* (Schiff.).**—*Canad. Ent.* **89** no. 8 pp. 379–383, 2 figs., 1 ref. Ottawa, 1957.

In an experiment in Ontario in 1956, radioactive cobalt (^{60}Co), selected because it emits γ-rays and has a sufficiently long half-life (5·3 years) [*cf. R.A.E.*, A **43** 70, etc.], was added as the nitrate at the rate of 2 mc. per 1·5 cc. to a stock solution of a water-resistant resin glue diluted 8:1 with water and coloured with methyl blue. It was brushed on to the dorsal abdominal segments of newly emerged females of *Rhyacionia buoliana* (Schiff.), anaesthetised with carbon dioxide, to form a thin film about $\frac{1}{4}$ in. long and $\frac{1}{8}$ in. wide, and only examples found to show 25–50 μc. ^{60}Co, which could be readily detected with a portable Geiger probe in the field at a distance of at least 3 ft., were used. The films did not hinder movements of the abdomen or normal flight, and were protected by the folded wings

when the insects were resting or crawling. Labelled insects were released at dusk on 11th July in a fairly isolated plantation of red pine [*Pinus resinosa*], but liberation was followed by a sudden storm with winds of up to 18 miles an hour that carried most of the moths through the plantation and, in some cases, out of it, and storms and high winds also limited subsequent surveys. Counts of living radioactive moths, which were usually not removed, and of predators, pine shoots, bird droppings, or other material showing radioactivity on the trees on 12th July showed a reduction of 60 per cent. in the number of tagged moths, which is attributed to the bad weather. Later surveys indicated that few of the remaining moths left the plantation until 18–19th July and confirmed unpublished findings by the senior author that the females do not fly to any extent until they have been fertilised and oviposition has begun. He also found that flight tends to be upwind at wind velocities of less than 6 miles per hour and downwind at higher wind speeds, and the distribution of radioactive insects and objects in the plantation was as would be expected from a consideration of the direction and velocities of the winds about the time of release. Labelled females were observed pairing and ovipositing on the trees, and 25 and 86 per cent. of the eggs laid by two placed in cellophane-lined petri dishes at the base of one of the trees were viable. Evidence was obtained that some of the radioactive cobalt was leached from the insects and absorbed by plant tissues, where it can be detected readily and removed by hand, but much of the radioactive material lost would be dispersed and carried into the soil, and this, combined with the foraging activity of ants, would greatly facilitate the decontamination of test areas.

Jones (P. A.) & Shenefelt (R. D.). **Control of the Pine Tortoise Scale by aerial Application of Insecticides.**—*Canad. Ent.* **89** no. 8 pp. 384–388, 3 refs. Ottawa, 1957.

Investigations on the control of *Toumeyella numismatica* (Pettit & Daniel) [*cf. R.A.E.*, A **44** 324] by means of insecticides were made in 1954 in a plantation of jack pine [*Pinus banksiana*] in northern Wisconsin, where a heavy outbreak that began in the previous year had killed trees over an area of 474 acres. Infested trees are characterised by their glistening appearance, caused by accumulated honeydew, the unequal growth of the main shoots, which is greatest in the upper third of the crown, the presence, after the first summer of heavy attack, of the translucent, white pupal cases of the males, and, in dying and dead trees, yellowing or browning of the foliage and the development of a black, sooty appearance. In laboratory dipping tests, aldrin, parathion, Systox [diethyl 2-(ethylthio)ethyl phosphorothioate (demeton)], malathion and Ovotran [p-chlorophenyl p-chlorobenzenesulphonate (ovex)] were more effective against immature female adults than were DDT, lindane [γ BHC], DN-289 [the triethanolamine salt of dinoseb] and schradan, but dusts and sprays of malathion, Ovotran, γ BHC and parathion, and sprays of Systox, endrin, aldrin, DDT, DN-289 and DN-111 [the dicyclohexylamine salt of dinoseb], applied to individual branches in the plantation in May, were of no value against the overwintering females. When newly hatched crawlers were exposed for 15 minutes on filter papers previously sprayed with solutions of the insecticides in acetone, DDT, Ovotran, endrin, Systox, DN-289, parathion and malathion gave better results than some others and did not differ significantly among themselves, though the last four appeared to be the most effective. In a field test, parathion, malathion and DDT were applied by aircraft to plots in the plantation, the treatments comprising a dust of DDT at 1 lb. toxicant per acre, dusts and emulsion sprays of malathion and parathion and an

emulsion spray of DDT, all at 0·8 lb. toxicant per acre, and a dust and an emulsion spray of DDT with malathion at 0·8 lb. of each toxicant per acre. Applications were made on 24th June, when hatching was at a peak, and the results were evaluated by counts after 24 and 72 hours of the crawlers that fell from the trees on to glass plates coated with an adhesive. Rain fell in the interim. Significantly the best control was given by malathion in all formulations during the first 24 hours and by the parathion dust during the next 48, and the total control from the latter compared favourably with that from the malathion treatments, which killed similar numbers of crawlers in each of the two periods. No harmful effects on vertebrates were caused by any of the materials tested.

Hill (C. H.) & Hough (W. S.). **The Unspotted Leaf Miner on Apple Trees.**—*Tech. Bull. Va agric. Exp. Sta.* no. 130, 21 [+1] pp., 6 figs., 10 refs. Blacksburg, Va., 1957.

The authors describe all stages and the bionomics of *Parornix* (*Callisto*) *geminatella* (Pack.) [*cf. R.A.E.*, A **4** 343], which became very injurious to apple in Virginia and neighbouring parts of the United States in 1954 and less so in 1955–56 [*cf.* **45** 188]. It is attacked by many natural enemies, which usually reduce infestation below the level causing severe foliage damage after one season. The older larvae in their mines are parasitised by *Apanteles ornigis* Weed, the most important of them, *A. tischeriae* Vier., *Elachertus coxalis* How. and *Sympiesis bimaculatipennis* (Gir.). *Horismenus microgaster* (Ashm.), *Catolaccus aeneoviridis* (Gir.) and *Hypopteromalus tabacum* (Fitch) are hyperparasites, attacking *Apanteles*; the first may also be a primary parasite. Overwintering larvae and pupae of *P. geminatella* are parasitised in their cocoons by an Ichneumonid, probably of the genus *Gelis*, and by *Sympiesis massasoit* Crwf.; a species of *Gelis* was reared from an overwintering cocoon of *Apanteles*. *Trichogramma* sp. occasionally parasitises the eggs, and *Chrysopa* larvae prey on the larvae after they have left the mines and before they have formed cocoons.

Spraying the foliage with 1–2 U.S. pints Systox [diethyl 2-(ethylthio)ethyl phosphorothioate (demeton)], 1 U.S. pint Thimet [O,O-diethyl S-ethylthiomethyl phosphorodithioate] or 2·5 lb. 25 per cent. malathion per 100 U.S. gals. on 31st October 1955 did not interfere with the emergence of primary or secondary parasites in the following spring, and spraying the ground cover with endrin in mid-March 1957, to control orchard mice, did not prevent the emergence of adults or of parasites and hyperparasites hibernating in the fallen leaves of a heavily infested orchard [*cf.* **46** 447].

In further tests of insecticides [*cf.* **45** 188–189] in a very heavily infested orchard, four cover sprays of 5 lb. Black Leaf 253 (a concentrate containing 25 per cent. DDT and 3 per cent. parathion) per 100 U.S. gals. between 6th May and 25th June 1954 gave satisfactory control, whereas DDT alone did not, and in 1955, two applications towards the middle and end of May of 3 lb. 15 per cent. parathion per 100 U.S. gals. gave commercial control of a moderate infestation throughout the season. The leaf-miner was not economically important in either of these orchards in 1956.

Single applications of effective insecticides were not always satisfactory when made at the pink or petal-fall stages (11th and 27th April) in 1955 or even when made as late as 18th July in 1956; nicotine sulphate and parathion were among the more effective insecticides in 1955, when applications of either tended to be more effective at the petal-fall than at the pink stage, but in 1956, when infestation increased from 5 mines per leaf in July to 52·9 in October in untreated plots, 1 lb. 15 per cent. parathion per 100 U.S.

gals. gave only 64 per cent. control, whereas 1 pint nicotine sulphate and 1 pint Guthion [O,O-dimethyl S-(4-oxo-benzotriazino-3-methyl) phosphorodithioate] per 100 gals. gave 93 and 84 per cent. Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] gave 86 per cent. control in applications at the petal-fall stage in 1955, before most of the eggs had hatched, but poorer results later in that season and in the next, when larvae were already present in mines.

Connola (D. P.), Waters (W. E.) & Smith (W. E.). **The Development and Application of a Sequential Sampling Plan for Forest Tent Caterpillar in New York.**—*Bull. N.Y. St. Mus.* no. 366, 22 pp., frontis., 3 figs., 9 refs. Albany, N.Y., 1957.

An outbreak of *Malacosoma disstria* Hb. began in northern New York in 1951 and reached its climax in 1954, when over 15 million acres of forest in the State were damaged. During this period, methods of mass sampling of the eggs to predict the degree and extent of defoliation in the following season were studied. The conventional method of taking fixed numbers of samples was used as a basis for developing a sequential sampling plan [*cf. R.A.E.*, A **44** 159]. In the developed plan, cut twig samples are taken from individual trees at selected sampling sites until the accumulated number of egg masses satisfies a predicted classification of either "noticeable" or "no noticeable" defoliation expected at the site. The merits of the plan were tested by comparison with data collected in a survey of the conventional type in 1953. It was found that, had the plan been available at the time, it would have saved 86·9 per cent. of the 444 man-hours spent sampling at 111 sampling sites. Instead of 25 trees per sampling site, it would have been necessary, in most cases, to sample only 3–4 trees. Defoliation records in 1954 showed that predictions based on the plan agreed satisfactorily with the 90 and 95 per cent. confidence levels set for it.

Whiteside (J. M.). **Spruce Budworm Control in Oregon and Washington, 1949–1956.**—[3+] 23 pp., 1 pl., 1 graph, 1 map, 19 refs., multigraph. Portland, Ore., Pacif. Nthwest For. Exp. Sta., 1956.

Whiteside (J. M.), Wessela (C. P.) & Compton (L. M.). **Report of the 1955 Oregon Spruce Budworm Control Project.**—[1+] iv + 60 pp., 7 pls., 4 figs., 1 map, 6 refs., multigraph. Portland, Ore., Pacif. Nthwest For. Exp. Sta., 1956.

It is stated in the first of these papers that *Choristoneura fumiferana* (Clem.), the bionomics of which are described, was of no importance on Douglas fir (*Pseudotsuga menziesii*) in the Pacific Northwest of the United States until 1943, when an outbreak developed in north-eastern Washington. A major outbreak began in north-eastern Oregon in 1944–46, and almost a million acres of forest in Oregon and Washington were infested in 1947. Aerial surveys were begun in that year, and the infested area increased until 1949, when over 2¼ million acres were infested. True firs (*Abies*) and Engelmann spruce (*Picea engelmanni*) were attacked, in addition to Douglas fir, though damage to this was the most important, as it is the predominant tree in the forests to the west of the Cascade Mountains. A large-scale experiment on control was carried out in May–August 1948 in eastern Oregon and showed that sprays affording 1 lb. DDT per acre in oil solution, applied from aircraft, were very effective against dense populations of larvae, 95 per cent. or more kill of late-instar larvae being obtained when

spraying was carried out on calm mornings. A control campaign, the details of which are described, was then begun, with the objects of protecting valuable forests, regardless of infestation intensity, treating centres of infestation near previously controlled units, to prevent reinfestation of the latter, and protecting stands in which tree-killing was imminent within 1–2 years. The programme was somewhat modified in 1951 owing to a widespread outbreak of *Dendroctonus pseudotsugae* Hopk. that developed on trees weakened through infestation by *C. fumiferana*, but the work was continued until 1955. Some 3,840,000 acres of forest, mostly in Oregon, were treated during this period, and 98·2 per cent. mortality of larvae, on the average, was obtained. The surveys in the autumn of 1955 showed that infestation was declining and the threat of tree mortality reduced, and the operation was therefore suspended.

Details of the work carried out in Oregon in 1955 are given in the second paper.

Vité (J. P.) & Rudinsky (J. A.). **Contribution toward a Study of Douglas Fir Beetle Development.**—*For. Sci.* 3 no. 2 pp. 156–167, 5 figs., 5 refs. Washington, D.C., 1957.

Investigations were carried out in the greenhouse in Oregon between November 1955 and September 1956 to determine the rate of development of the immature stages of *Dendroctonus pseudotsugae* Hopk. The beetles were obtained from logs of Douglas fir [*Pseudotsuga menziesii*] that had been cut in the spring of 1955, became infested in late May, contained young adults by mid-August and were brought into the greenhouse during the winter, where they were exposed to a temperature of 22°C. [71·6°F.]. The period of exposure necessary before emergence varied inversely with the amount of hibernation undergone, and was 2–6 weeks and less than one day, respectively, for logs brought in during November and on 2nd April. About 350 adults of *D. pseudotsugae* and 45 parasites (*Coeloides brunneri* Vier.) emerged from each 3-ft. log.

Within 24 hours of emergence, the beetles were caged at 22°C. with fresh logs sealed at the ends, and those that had not entered them after 24 hours were removed. The logs were stored at various constant temperatures and 50–60 per cent. relative humidity 12 hours later, and galleries were opened once or twice a day to determine the rate of development. The egg stage, four larval instars and pupal stage lasted about 6, 3–4, 5, 6, 15 and 9–10 days, respectively, at 21·5°C. [70·7°F.] and 6, 2·2, 2·8, 3·5, 13 and 5·5 days at 29–30°C. [84·2–86°F.], the temperature at which development was most rapid. The increase in the duration of development with decreasing temperature was particularly pronounced below 17°C. [62·6°F.], and no embryonic development occurred below 8°C. [46·4°F.]. Prolonged exposure to temperatures above 32–34°C. [89·6–93·2°F.] was lethal to eggs and first-instar larvae. Males and females occurred in equal numbers, but survival was much lower for the more exposed males; this did not seem to affect the reproductive potential, as males mated with more than one female. The number of eggs laid per day at 21·5°C. fell from 4–7 at the beginning of the reproductive period to about one a day after 2–3 weeks; some females had an extra ovariole, which increased egg production. About 30–60 eggs were usually found in a gallery, though there were occasionally almost 300.

In the field in 1956, total development required 76 days at average temperatures of 14–21°C. [57·2–69·8°F.] by day and 10·4–16·4°C. [50·72–61·52°F.] by night and 64 days at daily temperatures about 4–5°C. [7·2–9°F.] higher.

Morse (R. A.) & Kerr (S. H.). **A new Insect-Host Relationship.**—*Florida Ent.* **40** no. 3 pp. 77–80, 1 fig., 5 refs. Gainesville, Fla., 1957.

Adults of several species of Hymenoptera tunnel into the pith of cut or damaged rose stems in Florida in order to construct cells in which to lay eggs, and shoots that are pruned are sometimes attacked within half an hour. The injury causes die-back and facilitates attack by micro-organisms. The commonest of the species concerned in the Gainesville area is *Ectemnius texanus ais* Pate, which is active at all seasons and possibly has more than one generation a year. Females of this Sphecid provision the cells with small Diptera, and a list of those identified from four cells is given, together with notes on other Hymenoptera that cause similar injury to roses. To prevent the damage, the cut ends of pruned shoots should be treated with wound paint or covered with drawing pins.

Callahan (P. S.). **Oviposition Response of the Imago of the Corn Earworm, *Heliothis zea* (Boddie), to various Wave Lengths of Light.**—*Ann. ent. Soc. Amer.* **50** no. 5 pp. 444–452, 4 figs., 7 refs. Washington, D.C., 1957.

Laboratory tests having shown that females of *Heliothis zea* (Boddie) exposed to crepuscular light oviposited more readily on cloth than on plants, whether or not these belonged to species normally infested by this moth [*cf. R.A.E.*, A **46** 385], the oviposition response to light of different wavelengths was investigated in special cages holding 20–30 moths each in which light from two sources was projected through panels of white cloth at either end, the cloth serving as the oviposition surface. Polaroid variable-colour filters were used, and the light intensities were equalised. The experiments showed that, at equal light intensities, the females responded equally to 14 per cent. polarised light and unpolarised light. When lights of different wavelength were used, the shorter wavelength was always preferred, but there was less difference when the competing wavelengths were close together on the spectrum than when they were farther apart. The difference in response to wavelengths close to each other was only slightly less at the long end of the spectrum than at the short, and that to wavelengths farther apart was greater at the long than at the short end. The response to green seemed to decrease as the night progressed, but that to blue increased. Peaks of oviposition occurred, but these were probably due to temperature and time of pairing and not directly related to the light experiments.

Brazzel (J. R.) & Martin (D. F.). **Resistance of Cotton to Pink Bollworm Damage.**—*Bull. Tex. agric. Exp. Sta.* no. 843, 20 pp., 2 graphs, 52 refs. College Station, Tex., 1956.

The following is based on the authors' summary. Investigations were carried out at College Station, Texas, in 1954–55 to evaluate the resistance of available species and varieties of cotton to damage by *Platyedra* (*Pectinophora*) *gossypiella* (Saund.), 108 forms being used in preliminary greenhouse tests and upward of 30 in field tests; Deltapine 15 was the standard cotton used for comparison.

Bolls of one cross (Stoneville 2B × *Gossypium tomentosum*) showed a high degree of antibiosis [*cf. R.A.E.*, A **45** 352], apparently owing to a physiological response of the seed to injury; when the seeds were attacked, many of the larvae were engulfed and killed by extensive cell proliferation. Bolls of *G. thurberi* appeared to be less resistant to attack, but the results

were distorted by the extremely small size of the bolls [*cf.* **45** 16]. Hexaploid Z-64 bolls showed a still lower degree of resistance, the mechanism of which was not determined, and the other species and varieties none.

Morphological differences in the vegetative and fruiting parts of the plant caused modifications in the egg-laying habits of the moths. A tight-fitting calyx that was straight along the outer margin or had flared bracts discouraged oviposition on the bolls, whereas the ovipositing moths were attracted to vegetative parts with heavy coarse pubescence and leaves with heavy prominent veins. The physical characteristics of both vegetative and fruiting parts of *G. thurberi* discouraged oviposition, with the result that large proportions of the bolls escaped injury in all tests, even when other cottons were not available for oviposition.

The best approach to the development of a variety with resistance to damage by *P. gossypiella* would be by modification of the structural characters of the plant; flared or deciduous bracts, a tight straight calyx, coarse pubescence on the vegetative parts and heavy leaf veins should result in greater attraction to vegetative than fruiting parts for oviposition. The development of a plant of this type is presumably feasible, since all the characteristics are found among various species of cotton, and it would have several favourable effects on the control of the insect. Mortality from weather and other environmental factors would be much higher, since the first-instar larvae would have to migrate over the plant in search of food; eggs would be more accessible to predators and parasites on the vegetative parts than under the boll calyx; and insecticides applied to the plants would be more effective, since the migrating larvae would be more likely to come into contact with the deposits.

Jensen (D. D.). **Parasites of the Psyllidae.**—*Hilgardia* **27** no. 2 pp. 71–99, 75 refs. Berkeley, Cal., 1957.

During investigations in the United States, parasites comprising at least 15 species of Hymenoptera in eight genera were reared from Psyllids of 34 species in 11 genera, mostly from California. Some of these were new records, and the circumstances are described. Previously recorded observations on parasites of Psyllids throughout the world are reviewed. Except for Cecidomyiids of the genera *Endopsylla*, which is endoparasitic in the adults, and *Lestodiplosis* and *Bremia*, which are normally considered to be predacious, but are included because their relations to their hosts are imperfectly understood, all records are of Hymenoptera attacking the nymphs. The information is combined in two tables, of which the first comprises a list of the parasites, showing their hosts, and the second a list of the hosts, showing the parasites that attack them; both include geographical indications and references to the literature for the records cited.

Hall (I. M.) & Dunn (P. H.). **Entomophthorous Fungi parasitic on the Spotted Alfalfa Aphid.**—*Hilgardia* **27** no. 4 pp. 159–181, 14 figs., 17 refs. Berkeley, Cal., 1957.

Of the five species of entomogenous fungi that have been isolated from *Myzocallis* (*Therioaphis*) *maculata* (Buckt.) on lucerne in California [*cf. R.A.E.*, A **46** 124], one is considered to be *Entomophthora coronata* and the others are described as *E. obscura*, *E. ignobilis*, *E. exitialis* and *E. virulenta*, spp.n. The last two appear to be the most effective against the Aphid, and they have also been found infesting it in India, Iraq and Israel and in Israel, respectively, indicating that they contribute towards the

control of *M. maculata* in its native habitat. These fungi are all included in the genus *Entomophthora* because the authors do not consider that *Empusa*, which is an earlier name but is preoccupied in orchids, is distinct from it.

Waggoner (P. E.) & Kring (J. B.). **Use of Shade Tent and Insecticides in Studies of Virus Spread.**—*Phytopathology* **46** no. 10 pp. 562–563, 1 graph, 6 refs. Baltimore, Md., 1956.

Field observations on the spread of Aphid-borne viruses of plants are frequently hindered by a scarcity of Aphid vectors. The use of shade tents of the sort used for growing certain varieties of tobacco in the United States favours Aphids and excludes their natural enemies, and the plants in them can be freed from chewing insects by spraying with DDT or Dilan (a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane), which frequently results in an increase in Aphid populations. In a test in Connecticut in which potatoes were grown under such a tent and sprayed on various dates with Dilan, alone or with DDT, more Aphids (*Myzus persicae* (Sulz.) with a few of *Macrosiphum solanifolii* (Ashm.)) developed on the caged than on uncaged plants and more on the sprayed than on unsprayed plants in the field. Sprays of malathion applied in the tent in July controlled the Aphids and permitted survival of the haulms until harvest, whereas the plants sprayed with Dilan alone or with DDT were killed by the Aphids in early August. The greater number of Aphids in the tent was accompanied by greater spread of potato virus Y from interplanted infected source plants, and virus spread was not affected by a spray blast directed from the diseased to the healthy plants.

Raymer (W. B.). **Identity and Host Relations of the Potato Late-breaking Virus.** (Abstract.)—*Phytopathology* **46** no. 11 p. 639. Baltimore, Md., 1956.

A virus causing the late-breaking disease of potatoes in Oregon was recovered in *Nicotiana rustica* by grafting and transmitted for the first time by the aster leafhopper (*Macrosteles fascifrons* (Stål)) to tomato, Jimson weed [*Datura stramonium*] and ladino, red, alsike and crimson clover [*Trifolium repens latum*, *T. pratense*, *T. hybridum* and *T. incarnatum*]. Symptoms of aster yellows were produced in aster [*Callistephus*] and celery, indicating that the virus is that of western aster yellows. The symptoms caused in the other plants are briefly described.

Slykhuis (J. T.). **Wheat Spot Mosaic, caused by a Mite-transmitted Virus associated with Wheat Streak Mosaic.**—*Phytopathology* **46** no. 12 pp. 682–687, 3 figs., 1 ref. Baltimore, Md., 1956.

Aceria tulipae (Keifer), the vector of the wheat streak mosaic virus, sometimes carries another virus that causes chlorosis, necrosis and stunting of wheat in southern Alberta [*cf. R.A.E.*, A **45** 476] and is designated wheat spot mosaic. In tests, this virus was acquired from infected wheat plants and transmitted to healthy ones by adults of *A. tulipae* and nymphs in both instars. Infectivity was retained by the mites during moulting, but was not transmitted through the egg. Many other cultivated and wild grasses also proved susceptible to infection.

MARAMOROSCH (K.). **Cross-protection Studies of two Types of Corn Stunt Virus.** (Abstract.)—*Phytopathology* **47** no. 1 p. 23. Baltimore, Md., 1957.

In experiments with the two types of stunt disease of maize in Mexico [*cf. R.A.E.*, A **46** 17], the viruses were acquired in feeding periods of one day and transmitted after an incubation period of 2–3 weeks by either *Dalbulus maidis* (DeLong & Wolc.) or *D. elimatus* (Ball). When examples of *D. maidis* acquired the Mesa Central virus first and the Rio Grande virus a fortnight later, they transmitted them in the same order, but when the Rio Grande virus was acquired first, it was the only one transmitted. Similar results were usually obtained when the two viruses were acquired a week apart, but either was transmitted first when the interval was one day, irrespective of the order of acquisition, though the Rio Grande virus was predominantly and later exclusively transmitted in subsequent weeks. In plants simultaneously infected with both, symptoms of the Mesa Central virus were often observed in the beginning but those of the more severe Rio Grande virus developed later. The fact that the Rio Grande virus protected against the Mesa Central virus indicates strain relationship. The Rio Grande virus may move or multiply faster than the other, pre-empting certain insect and plant tissues and thus suppress transmission or multiplication of the Mesa Central virus.

SIMONS (J. N.). **Three Strains of Cucumber Mosaic Virus affecting Bell Pepper in the Everglades Area of South Florida.**—*Phytopathology* **47** no. 3 pp. 145–150, 2 figs., 9 refs. Baltimore, Md., 1957.

The following is based on the author's summary. Peppers (*Capsicum*) growing in the Everglades area of southern Florida were found to be infected by at least three different strains of the cucumber mosaic virus, southern cucumber mosaic being the commonest [*cf. R.A.E.*, A **45** 477]. They were closely related immunologically, and their physical properties, which are described, were identical. In tests, all three were transmitted in a non-persistent manner by *Aphis gossypii* Glov. and *Myzus persicae* (Sulz.), of which the latter proved the more efficient vector, and the southern strain was more readily transmitted than the others, which may account for its prevalence in the field.

SIMONS (J. N.). **Effects of Insecticides and physical Barriers on Field Spread of Pepper Veinbanding Mosaic Virus.**—*Phytopathology* **47** no. 3 pp. 139–145, 4 figs., 7 refs. Baltimore, Md., 1957.

An account is given of tests in Florida in 1954–55 to ascertain the effects of distance from a source of virus, effects of insecticides applied to natural sources and crop plants and the effect of a barrier crop on the spread of the virus of pepper veinbanding mosaic, which is transmitted by Aphids [*cf. R.A.E.*, A **46** 15]. The source of the virus was artificially infected nightshade (*Solanum gracile*), and the test plants were peppers (*Capsicum*). The principal Aphid vector present was *Aphis gossypii* Glov. The incidence of infection of the peppers was closely related to their proximity to the nightshade, and spread was effectively limited by an intervening distance of 150 ft. It was also reduced by parathion sprays applied to the nightshade to control the Aphids, but not by sprays of parathion or demeton (diethyl 2-(ethylthio)ethyl phosphorothioate) applied to the peppers. A barrier of sunflowers (*Helianthus*) between nightshade and peppers also reduced the spread of the virus to the latter, but spraying the barrier with demeton

afforded no further reduction. It is concluded that any programme for control of the virus should be based on elimination of the weeds that harbour it.

Crall (J. M.) & Stover (L. H.). **The Significance of Pierce's Disease in the Decline of Bunch Grapes in Florida.** (Abstract.)—*Phytopathology* **47** no. 9 p. 518. Baltimore, Md., 1957.

Studies were begun in Florida in 1955 on the importance of Pierce's disease of grape vines in the decline of grapes grown for the table. Vines with shoots exposed to attack by naturally occurring vectors of the virus [*cf. R.A.E.*, A **43** 271–272] developed typical symptoms and were dead within 18 months, regardless of whether they were planted in the field or in pots of fumigated soil, whereas those with shoots screened from insects remained healthy. When series of ten vines were grown in screen cages into which known or suspected vectors were introduced, the percentages of dead vine prunings nine months after exposure were 31 for *Carneocephala flaviceps* (Ril.), 61 for *Homalodisca* spp. (*H. triquetra* (F.), *H. insolita* (Wlk.) or both), and 73·9 for *Oncometopia undata* (F.), as compared with 15·8 for vines protected from insects. It is concluded that Pierce's disease is the major factor responsible for the decline in Florida.

Ogawa (J. M.). **The Dried Fruit Beetle disseminates Spores of the Peach Brown Rot Fungus.** (Abstract.)—*Phytopathology* **47** no. 9 p. 530. Baltimore, Md., 1957.

Adults of *Carpophilus hemipterus* (L.) collected while feeding on peach fruits infected with brown rot (caused by *Sclerotinia fructicola*) on the trees or ground in orchards in the Sacramento Valley of California were found to be contaminated with spores of the fungus. Field observations show that the disease originates in many cases in natural injuries on the fruits, and when contaminated beetles were caged on peach trees, they were attracted to natural or artificial wounds and spread the infection to them. The practice of flood irrigation, which covers the insect-infested diseased fruits on the ground, induces the beetles to move into the trees in search of further food, and is thought to conduce in this way to dissemination of the fungus.

Palmiter (D. H.) & Adams (J. A.). **Seasonal Occurrence of Leafhopper Vectors of X-disease Virus in sprayed and unsprayed Peach Blocks.** (Abstract.)—*Phytopathology* **47** no. 9 p. 531. Baltimore, Md., 1957.

In investigations on the vectors of the X-disease of peach in the United States [*cf. R.A.E.*, A **39** 399], Cicadellids were collected by means of adhesive traps hung in peach trees at weekly intervals from May to November in 1955 and 1956 and sprays of DDT and malathion were applied at intervals of ten days to half the orchard. *Scaphytopius acutus* (Say) [*cf.* **44** 382, etc.] was the commonest species collected. It was first taken in the second week in June, reached peak numbers in early July, and was rare from mid-July to mid-August. A late brood reached its peak in September but individuals were still present in November. *Colladonus clitellarius* (Say) was collected during the same periods but in smaller numbers. A total of seven sprays gave good control of *S. acutus* in 1955, but the reduction was slight in 1956, and the presence of vectors over such a long period seemed to preclude the use of sprays to reduce the spread of the virus.

Williams (W. L.) & Ross (A. F.). **Acquisition and Test Feeding Periods required on *Physalis floridana* and *Datura stramonium* for Aphid Transmission of Potato Leafroll Virus.** (Abstract.)—*Phytopathology* **47** no. 9 p. 538. Baltimore, Md., 1957.

The minimum time required for acquisition of the virus of potato leaf-roll by *Myzus persicae* (Sulz.) from infected *Physalis floridana* or *Datura stramonium* was ½ hour. Groups of five Aphids given such acquisition periods did not transmit the virus to seedlings of *D. stramonium* during test feedings of ½ hour or more, but some groups transmitted to seedlings of *P. floridana* during the first ½ hour of test feeding. Aphids reared on infected *D. stramonium* effected transmission to *D. stramonium* and *P. floridana* in 10 and 3 minutes, respectively. Such Aphids transmitted the virus with equal facility to the two species during test feedings of 15–30 minutes. The total time necessary for transmission from *D. stramonium* to *D. stramonium* decreased as the duration of acquisition feeding was increased; the shortest total transmission time was 29 hours, consisting of acquisition and test feeding periods of 17 and 12 hours, respectively. Following acquisition feeds of 1, 5 and 10 hours, Aphids did not transmit during the first 24, 36 and 12 hours, respectively, of test feeding on *D. stramonium*. The explanation for failure to obtain transmission to *D. stramonium* when short acquisition and test feeding periods were used appears to be that this plant is relatively resistant to small doses of the virus.

Williams (W. L.) & Ross (A. F.). **Aphid Transmission of Potato Leafroll Virus as affected by the Feeding of nonviruliferous Aphids on the Test Plants and by Vector Variability.** (Abstract.)—*Phytopathology* **47** no. 9 p. 538. Baltimore, Md., 1957.

A previous report that the probability that a single Aphid (*Myzus persicae* (Sulz.)) can effect transmission of the virus of potato leaf-roll decreases as the number of Aphids per plant is increased was confirmed. The depression in individual efficiency occurred with both 24-hour and five-day test feeds on *Physalis angulata*; it appears to result in part from interference by a colony with the feeding of individuals and in part from an effect of Aphid feeding on susceptibility of the test plant. Susceptibility of the seedlings was not greatly affected by the feeding of non-viruliferous Aphids (5–10 per plant) for five days before or after an inoculation feed of 15 hours or five days, but it was lessened appreciably by the feeding of five or more non-viruliferous Aphids for 12 days prior to an inoculation feed of five hours. These data suggest that the susceptibility of *P. angulata* is decreased by Aphid feeding, but that this effect is not great enough to explain entirely the relative inefficiency of individuals in a colony. The marked variation in ability of individuals to transmit leaf-roll virus appears to be due to heritable characters. The progeny of individuals that were good transmitters were efficient vectors, and those of poor transmitters were inefficient vectors.

McLean (D. M.). **Effect of Insecticide Treatments of Beets on Transmission of Yellows Virus by *Myzus persicae*.—*Phytopathology* 47** no. 9 pp. 557–559, 7 refs. Baltimore, Md., 1957.

In the first of the experiments described, which were carried out in Washington State in 1955–56, apterae of *Myzus persicae* (Sulz.) that had fed for 24 hours or more on beet infected with the yellows virus were caged on healthy beet seedlings that were growing in pots and had been treated with various insecticides in emulsion sprays. The latter comprised 47·5 per cent.

Thimet (O,O-diethyl S-ethylthiomethyl phosphorodithioate) at 1·25 ml., 26·2 per cent. demeton (diethyl 2-(ethylthio)ethyl phosphorothioate) at 1·25 ml., 25 per cent. parathion at 2·5 ml., Metacide (10 per cent. parathion and 40 per cent. methyl-parathion) at 1·25 ml. and 57 per cent. malathion at 1·87 ml. per litre. In the first test, the Aphids were allowed to feed in batches of ten for 20 minutes on five successive sprayed plants as soon as these had dried. They did not become inactive and unable to feed until after the last transfer, regardless of the insecticide used, and some Aphids infected each of the plants on which they fed. In the next test, successive batches of Aphids were allowed to feed on the sprayed plants for 24 hours until it was found that most of them were still alive at the end of the feeding period. The results showed that Thimet and demeton retained their toxicity for 18–24 days, and Metacide, parathion and malathion for 12–16, 8–14 and 6–10 days, respectively.

In another experiment, the sprays were applied to all but one of the leaves of beet plants and successive batches of Aphids were allowed to feed for eight hours on each unsprayed leaf, to ascertain the period required for translocation of the insecticides to the latter. Thimet and demeton reached the unsprayed leaves in 18–24 hours, but the others were not translocated in lethal amounts. When beet seed was coated with Thimet, Aphids caged on the leaves of the seedlings 21 days later were not killed by continuous feeding.

Although the conditions of the experiments were not identical with those in the field, the results help to explain the failure of insecticides to afford control of the yellows disease through their effect on its Aphid vectors [*cf. R.A.E.*, A **45** 455, etc.].

Jensen (D. D.). **Differential Transmission of Peach Yellow Leaf Roll Virus to Peach and Celery by the Leafhopper,** *Colladonus montanus*.—*Phytopathology* **47** no. 10 pp. 575–578, 9 refs. Baltimore, Md., 1957.

Colladonus geminatus (Van D.) is usually considered to be the most important of the insect vectors of the virus complex known as western X-disease of stone fruits [*cf. R.A.E.*, A **46** 444, etc.], particularly in the Pacific Northwest of the United States. *C. montanus* (Van D.) is closely related to it, has the same geographic range and other characteristics, and has been reported to transmit western X-disease [*cf.* **42** 299], but not the member of the complex known as peach yellow leaf-roll. Investigations were therefore carried out in California on its comparative abundance and its ability to transmit this strain.

Although *C. geminatus* is common and much the more abundant of the two Cicadellids in the Northwest, they vary in numbers in California, and catches in the peach-growing area of Yuba and Sutter counties in 1951–54 showed that *C. montanus* was consistently the more numerous there, though neither was present in large numbers; it was about ten times as abundant as *C. geminatus* in the district in which peach yellow leaf-roll occurs.

In the earlier of the author's transmission tests with *C. montanus*, peach was the source of the virus, acquisition feeding times as long as 18 days were achieved by feeding the adults alternately on peach and celery (since peach is not a favourable food-plant), and the insects were then kept on celery for several weeks to allow for incubation of the virus (which usually requires 30–45 days in *C. geminatus*) before being transferred, usually singly, to healthy peach. No transmission resulted. In other tests, nymphs from eggs laid on diseased peach trees were allowed to feed for 20–30 days on the trees and the survivors transferred to healthy peach. One of two healthy trees on each of which 15 nymphs fed developed symptoms of the disease.

The discovery that celery is susceptible to infection with the virus [*cf.* **45** 202] led to more extensive tests in 1956. The virus was transmitted to 38 of 48 healthy celery plants by batches of 4–15 or 37–100 insects that had fed in the nymphal stage on diseased ones for 4–6 days and in the adult stage on the healthy ones for four, after an interval of 30 days, and to one or more healthy celery plants by 15 of 20 adults that fed singly as nymphs on infected plants for seven days and on successive healthy ones for 1–3 days 41 days later. When 38 groups of 4–10 uninfected nymphs were allowed to feed for 4–6 days on infected celery and were transferred after 33–43 days on healthy celery to alternate peach and celery plants, on which the insects fed for 24 hours each, 57 of 213 celery plants became infected, but only 4 of 238 peach trees.

It is concluded that *C. montanus*, though commoner than *C. geminatus* in California, is of less importance as a vector of the yellow leaf-roll virus.

Sheffield (F. M. L.). **Virus Diseases of Sweet Potato in East Africa. I. Identification of the Viruses and their Insect Vectors.**—*Phytopathology* **47** no. 10 pp. 582–590, 2 figs., 22 refs. Baltimore, Md., 1957.

The following is based almost entirely on the author's summary. At least two viruses attack sweet potato in East Africa [*cf. R.A.E.*, A **33** 329]. One, referred to as virus A, was found only near Moshi, in Tanganyika, caused only a mild disease and was transmitted by *Myzus persicae* (Sulz.), which acquired it in feeding periods of two minutes. The other, virus B, was widely distributed in Kenya and Uganda and was transmitted by *Bemisia tabaci* (Gennadius), but not by other insects or mites. *B. tabaci* acquired it in feeding periods of five minutes, but was a very inefficient vector. Virus B exists in a number of strains, some of which cause very severe diseases. Virus A did not protect from virus B, but infection with a mild strain of the latter protected against a severe strain. Neither was transmitted mechanically. Infection with virus B may be masked or not fully systemic in dull cold conditions, but all attempts to inactivate it in the tubers before germination by heat treatment or chilling failed.

Bird (F. T.). **On the Development of Insect Viruses.**—*Virology* **3** no. 1 pp. 237–242, 3 figs., 8 refs. New York, N.Y., 1957.

The following is virtually the author's summary. A study of thin sections of nuclei infected with a polyhedral virus in *Neodiprion pratti banksianae* Rohw. suggests a cycle of virus development [*cf. R.A.E.*, A **44** 31–32] commencing with the attachment of rod-shaped particles to strands of chromatin. Apparently, the chromatin is then converted to virus, in form of minute spherical bodies surrounded by membranes, that increase in size to form rods. The rods may escape from their developmental membranes to repeat the cycle, or rods and spheres may be occluded by protein material to form polyhedra, in which case virus development ceases.

Costa (A. S.), de Silva (D. M.) & Duffus (J. E.). **Plant Virus Transmission by a Leaf-miner Fly.**—*Virology* **5** no. 1 pp. 145–149. New York, N.Y., 1958.

Liriomyza langei Frick was common on wild and cultivated plants in the Salinas Valley of California in the latter part of 1956, and as the females of this leaf-miner feed by lacerating the leaves with the ovipositor and sucking the cell contents and are very mobile, their ability to transmit viruses of plants mechanically was investigated. Batches of 25–50 adults,

either field-collected or reared in the laboratory, were allowed to feed for a few hours on a virus-infected plant in a cage, and two healthy plants, usually seedlings, were then introduced and left with the other, but not in contact with it or the cage, for 24–48 hours, after which they were transferred to a greenhouse bench and observed for symptoms. The flies fed well on sugar-beet and spinach infected with beet-mosaic virus, fairly well on lettuce infected with lettuce mosaic, and to some extent on tomato and poorly on tobacco infected with tobacco-etch virus, but effected no transmission from them or from *Nicotiana glutinosa* infected with cucumber mosaic. They transmitted sowbane mosaic from sowbane (*Chenopodium murale*) to 60 of 166 healthy sowbane plants, but not to *C. amaranticolor*, and tobacco mosaic from various sources to 3 of 61 plants of *C. murale* and 8 of 25 petunias, but not to tomato or tobacco (*N. tabacum*). This is apparently the first record of virus transmission by an Agromyzid; it is effected probably by means of the ovipositor, but possibly by the mouth-parts.

Jahn (E.). **Insektenviren.** [Insect Viruses.]—*Probl. Bioklimat.* **4**, $9\frac{1}{4} \times 6\frac{1}{4}$ ins., xii + 200 pp., 67 figs. (2 col.), 11 pp. refs. Leipzig, Akad. Verlagsges. Geest & Portig K.-G., 1958. Price *DM.* 24.

This survey of the relations between insects (or other arthropods) and viruses is based on literature published up to about the end of 1956 and the author's own investigations. The first chapter comprises an introductory review of the general properties of viruses, the inclusion bodies associated with some of them, their multiplication in their hosts, and methods of isolating them. The second is devoted to viruses pathogenic to insects and consists of a review of the types of disease concerned, with the insects susceptible to them, the symptoms caused, the internal course of the disease, the properties of the viruses, the inclusion bodies and the relations of the viruses to them, the transformations undergone by polyhedra, the modifications of the tissues induced by viruses, their pathogenicity, and the problems of latency and transmission through the insect egg. The third is concerned with viruses pathogenic to plants, and viruses and rickettsiae pathogenic to man or domestic animals, that are transmitted to them by insects or other arthropods. Lists of the known vectors are given, showing the diseases transmitted by them; the common properties of the vectors, the mode of transmission and the relations of the vectors to the viruses and rickettsiae are discussed; some of the more important of the agents concerned and their relation to the tissues of the host are described, with their effects, if any, on the vectors; and the course of the virus or rickettsia in the body of the vector, and the multiplication and transmission through the arthropod egg of plant viruses are reviewed. The fourth chapter comprises a discussion of the diverse factors on which the occurrence of virus diseases pathogenic to or transmitted by insects depends, the fifth is a discussion of the various theories as to the nature and origin of viruses, and the sixth is a review of work on the use of viruses for the control of insect pests of plants and of methods of controlling insects that transmit plant viruses.

Fernández (A.). **Las "escamas palomillas" del cafeto en Venezuela y avances logrados en su control químico.** [The Coccids of Coffee in Venezuela and Advances made in their Chemical Control.]—*Agron. trop.* **7** no. 1 pp. 7–17, 4 graphs, 5 refs. Maracay, 1957. (With a Summary in English.)

The principal pests of coffee in Venezuela are Coccids that suck the roots and are fostered by ants that feed on the honeydew excreted by them.

The most injurious is *Neorhizoecus coffeae* (Laing), which predominates in the Federal District and the States of Aragua, Carabobo and Monagas, but others comprise *Toumeyella* sp., in Táchira, and two unidentified species of *Pseudococcus*, a pink one in Mérida and a white one that is rare and of little importance. The loss of sap weakens the plants and causes leaf-shedding and even death. Tests on control by means of emulsion sprays applied to the soil within a radius of 20 ins. round individual trees at a rate of a little over a gallon per tree were carried out in five districts in 1954, and good control of *Neorhizoecus*, *Toumeyella*, the white species of *Pseudococcus* and the associated ants, lasting for over a year, was given by 1 per cent. of a product containing 23 per cent. aldrin and 0·5 per cent. of products containing 19·5 per cent. endrin or 74 per cent. chlordane. In 1956, wettable powders were applied directly to the soil, so as to economise water. When they were applied at 100 g. per tree, the best results were given by powders containing 20 per cent. aldrin or endrin or 40 per cent. chlordane, which remained effective for at least nine months. Aldrin proved as effective at 50 as at 100 g., but not at lower rates, and better results were obtained when it was scattered on the surface or mixed with the upper soil than when it was applied in holes round the tree.

de Almeida (P. R.), Giannotti (O.), Neves (O. S.) & Martinelli (E. S.). **Ensáios sôbre o contrôle do pulgão do algodoeiro (*Aphis gossypii* Glover), por meio de tratamento das sementes com inseticidas sistêmicos e pulverizações concentradas. Sua importância na produtividade do algodoeiro.** [Tests on the Control of the Cotton Aphid (*A. gossypii*) by Means of Seed Treatment with Systemic Insecticides and concentrated Sprays. Its Importance in the Production of Cotton.]—*Biológico* **23** no. 8 pp. 145–156, 1 fig., 8 refs. São Paulo, 1957.

In experiments in São Paulo, Brazil, in the season of 1955–56, cotton seeds were mixed with 4 per cent. of their weight of schradan or about 2 or 4 per cent. of Thimet (O,O-diethyl S-ethylthiomethyl phosphorodithioate), absorbed on activated carbon, and sown in field plots on 21st November; in one series, treatment with Thimet at 2 per cent. was supplemented by soil treatment with the same insecticide in open furrows close to the plant rows on 24th February. Untreated seeds were also sown, and, apart from control plots, the plants from these were treated on 2nd January with concentrated sprays affording 5 kg. toxaphene, 0·9 kg. schradan with a wetter, 0·3 kg. Thiometon [O,O-dimethyl S-2-(ethylthio)ethyl phosphorodithioate] or 0·38 kg. of Hercules 528, a non-systemic phosphorodithioate [2,3-p-dioxandithiol S,S-bis(O,O-diethyl phosphorodithioate)] per alqueire [24,200 sq. metres or nearly 6 acres]. All plots except the controls and those given the supplementary soil treatment with Thimet received low-volume sprays of toxaphene and endrin on 24th February and 10th April, respectively, in view of a light infestation by bugs, which, however, did not increase.

None of the treatments had much effect on germination, which was low throughout. Counts of *Aphis gossypii* Glov. were made on 30th December, before the sprays were applied, and on 4th January. Those made on the first date showed that the various seed treatments with schradan and Thimet had reduced the number of Aphids by 96·2–99 per cent., and those on the second that the percentage reductions for the concentrated sprays were 99·8 for schradan, 99·7 for Thiometon, 93·6 for toxaphene and 81·8 for 528. No further results were considered, as the Aphid population was reduced by bad weather. No other pests were present in significant numbers. Counts of buds and bolls were begun on 3rd February; increases

ranging from 33·9 to 69·5 per cent. were given by the seed treatments, increases of 20·3 and 11·9 per cent. by the sprays of Thiometon and toxaphene, respectively, and reductions by the other two sprays. Increases resulted from all treatments at a second count, on 24th March, and at a third, on 10th April, they were 68·6 per cent. for schradan and 78·4 and 96 per cent. for Thimet at 2 and 4 per cent. in the seed treatments and 23·5, 50·9, 17·6 and 19·6 per cent. for schradan, Thiometon, 528 and toxaphene in the sprays; the results given by toxaphene had been reduced by a period of drought after the second count, and only a very small increase was obtained when seed treatment with Thimet was followed by the supplementary soil treatment, which had apparently proved injurious to the plants. These results were reflected in the yields obtained, which showed increases of 75, 77·4 and 76·6 per cent. for seed treatment with schradan and 2 and 4 per cent. Thimet, respectively, and no significant increases for the other treatments. It is calculated from these figures that the reduction in yield caused by *A. gossypii* is of the order of 42–44 per cent. The seed treatments also resulted in an improvement in the quality of the lint.

Puzzi (D.) & Andrade (A. C.). **O "percevejo castanho"—*Scaptocoris castaneus* (Perty)—no estado de São Paulo.** [*S. castaneus* in the State of São Paulo.]—*Biológico* **23** no. 8 pp. 157–162, 2 figs. São Paulo, 1957.

Scaptocoris castaneus Perty causes severe injury to several crop plants of importance in São Paulo by sucking the roots in its nymphal and adult stages. Sugar-cane is the most severely attacked, and experiments have shown that soil treatment with toxaphene, aldrin, BHC or chlordane gives good control [*cf. R.A.E.*, A **42** 326, etc.]. Suitable rates of application are suggested, and methods of application described.

Risco Briceño (S. H.). **La mosca indígena *Paratheresia claripalpis* W. en el control biológico de *Diatraea saccharalis* Fabr. en el Perú. Observaciones sobre su biología, cria artificial y parasitismo natural en los campos de caña de azúcar.** [The indigenous Fly, *P. claripalpis*, in the Biological Control of *D. saccharalis* in Peru. Observations on its Biology, artificial Rearing, and natural Parasitism in Sugar-cane Fields.] —32 pp., 8 pls., 17 refs. Lima, Soc. nac. Agrar., Com. Prod. Azúc., 1954. **El Valle de Pativilca y el control biológico del borer: *Diatraea saccharalis* Fabr.** [The Valley of Pativilca and the Biological Control of the Borer, *D. saccharalis*.]—*Azúcar* **3** no. 11 pp. 31–40, 1 fig., 1 map. Lima, 1956.

It is stated in the first of these papers that a campaign for the biological control of *Diatraea saccharalis* (F.) on sugar-cane in Peru was begun in November 1951. The Tachinid parasite, *Lixophaga diatraeae* (Tns.), was introduced and liberated on a large scale in 1952–53 [*cf. R.A.E.*, A **42** 374], but the results were unsatisfactory, and the parasitism obtained nowhere exceeded 1 per cent. in spite of continuous releases. As a consequence, the São Paulo race of *Metagonistylum minense* Tns. was introduced in November 1953, and further attention was given to the indigenous *Paratheresia claripalpis* (Wulp), which regularly affords some 30 per cent. and sometimes as much as 70 per cent. parasitism of *D. saccharalis* [*cf.* **42** 375]. The author reviews the distribution, hosts, morphology and bionomics of the latter Tachinid, describes the method by which it was reared on a

large scale in the laboratory for field release, and notes the seven species of Hymenopterous parasites that attack it. Observations in November 1951 showed that *P. claripalpis* was not present in the Valley of Pativilca, although it had previously occurred there. Releases were begun in 1953, and parasitism rose rapidly in 1954, reaching nearly 24 per cent. in July. Liberations were also made in four other valleys.

In the second paper, the author discusses possible causes for the earlier disappearance of *P. claripalpis* from Pativilca, which include infestation of the prepupae and pupae by a fungus of the genus *Cordyceps*, and gives details of the parasite releases made and the results obtained in 1954, when parasitism averaged 8 per cent., and in 1955, when it averaged 11·8 per cent. but was very much higher in some fields. In the latter year, the infestation of internodes by *D. saccharalis* was reduced by 38·5 per cent., as compared with 1952, before the releases were begun.

Risco (S. H.). **Principales insectos que atacan a la caña de azúcar en el Perú.** [The principal Insects that attack Sugar-cane in Peru.]—*Azúcar* **3** no. 11 pp. 41–55, 13 figs., 11 refs. Lima, 1956.

Notes are given on the bionomics and natural enemies of some 15 insects that injure sugar-cane in Peru, with information on the control of some by means of insecticides. The only one not previously recorded is the Elachistid, *Dicranoctetes* (*Donacivola*) *saccharella* (Busck) [*cf. R.A.E.*, A **22** 186], which mines the leaves but is usually controlled by parasites.

Pearson (E. O.) (assisted by R. C. Maxwell Darling). **The Insect Pests of Cotton in Tropical Africa.**—10½ × 7 ins., x + 355 pp., 8 col. pls., 16 figs., 25 pp. refs. London, Emp. Cott. Gr. Corp. & Commonw. Inst. Ent., 1958. Price £2. (Obtainable from Commonw. Inst. Ent.)

This monograph on the insects and a few other arthropods associated with cotton in Africa south of the Sahara provides the specialist working on African cotton-pest problems with a comprehensive summary and critical review of the available information, formerly widely scattered through the literature, as well as serving non-specialists concerned with cotton-growing. Additional, unpublished information derived from the author's experience in Africa is included.

There are two introductory sections. The first (pp. 5–17) contains an account of the botany of the cultivated cottons, and, for Africa, the origins of those occurring there, the distribution of the wild representatives of *Gossypium*, the organisation and methods of cultivation of the crop, and the principal zones in which it is grown. The second (pp. 18–45) comprises a general account of cotton pests as regards the systematic groups to which they belong, their geographical distribution (by continents) and the probable origins of their association with cotton, together with a review of the insects and diseases that attack the different parts of the plant in Africa, a discussion of their effects on yield, and a series of brief descriptive notes (pp. 35–45) on each of the cotton-growing areas in Africa south of the Sahara and its principal pests. There is a key to the disorders affecting cotton in Africa (pp. 46–52), based on symptoms visible in the field.

The greater part of the book (pp. 53–310) consists of an account of each of the more important pests, dealing with the taxonomy and distribution, appearance of the different stages, life-history and seasonal activity, nature of the damage inflicted on cotton, food-plants, natural enemies, factors affecting prevalence, and control. The pests are arranged under Orders,

and then according to the part of the plant that they attack. About 150 species that occur on cotton in tropical Africa are mentioned, of which those dealt with in the greatest detail are *Earias* spp. (pp. 74–95), *Diparopsis* spp. (pp. 96–141), *Heliothis armigera* (Hb.) (pp. 142–160), *Platyedra gossypiella* (Saund.) (pp. 164–200), *Helopeltis* spp. (pp. 204–213), *Empoasca* spp. (pp. 215–226), *Aphis gossypii* Glov. (pp. 227–232), *Bemisia tabaci* (Gennadius) (pp. 232–236), *Lygus vosseleri* Popp. (pp. 236–246), and *Dysdercus* spp. (pp. 256–297). For species or groups not confined to tropical Africa, relevant matter available from research on them elsewhere is included. There is an Appendix by R. C. Maxwell Darling (pp. 311–314) on the use of insecticides on cotton in Africa, particularly the Sudan Gezira.

Odhiambo (T. R.). **The Bionomics of *Oxycarenus* Species (Hemiptera, Lygaeidae), and their Status as Cotton Pests in Uganda.**—*J. ent. Soc. S. Afr.* **20** no. 2 pp. 235–249, 31 refs. Pretoria, 1957.

The following is based almost entirely on the author's summary. *Oxycarenus dudgeoni* Dist., *O. fieberi* Stål and *O. rufiventris* (Germ.) were found on cotton and on wild malvaceous plants at Serere Experiment Station, Uganda, in 1955–56. *O. dudgeoni* was commonest on cotton, *O. fieberi* on *Sida* spp. and *O. rufiventris* on *Hibiscus cannabinus*, to which it was almost exclusively confined [*cf. R.A.E.*, A **14** 554]. Breeding took place only when mature seeds were available, and ovipositing females of *O. dudgeoni* and *O. fieberi* were shown to prefer seedheads of *Sida* to cotton seeds. Mature females paired even when their ovaries were depleted of eggs. Eggs were usually laid in small clusters, and oviposition extended over 2–3 days. The egg stage lasted 3–5 days, and the entire life-cycle 30–35 days. Cotton fields were infested by adults migrating from *Sida* and *Hibiscus* plants near and within them. Populations built up rather rapidly, but the increase appeared to be checked by rainstorms, which destroyed the younger nymphs. The embryos and endosperm of seeds from heavily infested bolls were shrunken, but staining of the lint and contamination by cast skins and dead bodies was negligible. Damage by the Lygaeids was associated with a reduction in the germinating power of the seeds, though the extent to which this was lowered did not seem to depend on the number of adults per boll. It is concluded that *Oxycarenus* spp. are minor pests of cotton in Uganda. A Reduviid, *Nagusta* sp., was observed feeding on nymphs and adults of all three species in an uncultivated field, but was not seen on cotton. Suggested cultural methods of control comprise clean cultivation, burning old cotton stalks with bolls, exposing the picked cotton to the sun to enable the Lygaeids to crawl away, storing the lint for at least a week before ginning to eliminate any that survive, and picking mature cotton at short intervals.

Smit (C. J. B.). **The relative Potency of BHC Sprays and Dusts against Hoppers of the Brown Locust.**—*J. ent. Soc. S. Afr.* **20** no. 2 pp. 344–352, 1 graph, 5 refs. Pretoria, 1957.

The relative toxicity of sprays and dusts of γ BHC against hoppers of *Locustana pardalina* (Wlk.) was investigated in an outbreak area in the Cape Province of South Africa in February and March 1953. Four tests were made under broadly similar conditions of weather and vegetation, in each of which a large band of fourth-instar hoppers was divided into smaller units, about 20 sq. yards in area, by means of circular metal barriers erected in the late afternoon when the hoppers were densely packed, and the

different formulations were applied about 1–2 hours after sunrise, sprays at about 35 gals. and dusts at about 10 lb. per acre. Mortality was assessed after 24 hours in samples collected immediately after treatment and kept in cages in the open air, and the results were pooled for statistical analysis by the probit method. The results showed that the amounts of γ BHC in oz. or fl. oz. per acre required for 50, 95 and 99 per cent. kill were 0·597, 2·648 and 4·908 for a miscible-oil emulsion spray, 1·167, 5·176 and 9·594 for a wettable-powder spray, 2·621, 11·62 and 21·55 for a wettable powder applied as a dust, and 4·883, 21·66 and 40·15 for an ordinary non-wettable dust.

Skaife (S. H.). **The Durban Dry-wood Termite** *Kalotermes durbanensis*, **Haviland.**—*J. ent. Soc. S. Afr.* **20** no. 2 pp. 373–390, 6 figs., 8 refs. Pretoria, 1957.

The following is based on the author's summary. *Kalotermes durbanensis* Hav., which is widespread in Africa, proved a suitable subject for laboratory investigation, and methods for rearing it in different types of artificial nests are described. It was found in dead branches of several indigenous bushes and trees in the Cape Peninsula, and, in laboratory tests, it fed on paper, especially newsprint made from coniferous wood pulp, and sawdust fixed with 3 per cent. agar, especially if derived from partly decayed wood. Exposure to 36°C. [96·8°F.] for 24 hours had little effect on the termites or their intestinal protozoa, but exposure for two or three hours to −10°C. [20°F.] was harmful. Secondary reproductives are rare under natural conditions and appeared erratically in artificial nests. Nymphal development lasted more than a year. Alates developed during the summer, and some that appeared in March remained in the nests throughout the winter. Nuptial flights take place at night, between November and March. The primary queens are not very prolific, and the largest colonies collected in the field numbered only a few hundred individuals.

Harris (W. V.). **More about Dry-wood Termites.**—*E. Afr. agric. J.* **23** no. 3 pp. 161–166, 4 figs. Nairobi, 1958.

The author describes the habits of dry-wood termites and the methods of preventing and controlling infestation of timbers by them, and states that whereas damage by them in buildings on the coast of East Africa was formerly attributed to *Cryptotermes havilandi* (Sjöst.) [*cf. R.A.E.*, A **31** 351], recent investigations have shown that it is in fact caused by *C. dudleyi* Banks. *C. havilandi* is a serious pest of buildings along the coast of West Africa from the Ivory Coast to the Belgian Congo, but though it may occur in East Africa, it does not injure domestic woodwork there. *C. dudleyi* occurs in Indonesia, New Guinea, a few small islands off the north coast of Australia, Ceylon (whence it probably reached East Africa) and parts of Central America [*cf.* **25** 598]. A survey in 1953–55 showed that it is present and injurious in all the larger towns along the coast of East Africa from Malindi in Kenya to Mikindani in southern Tanganyika and in Zanzibar, but does not occur inland. It has been found in the main timbers of many older buildings and is now appearing in more modern ones regarded as immune from termite attack because of precautions taken against the subterranean termite, *Coptotermes amanii* (Sjöst.). The most important dry-wood termites in other parts of the world are *Cryptotermes domesticus* (Hav.) in the Far East, and *C. brevis* (Wlk.) in America, various Pacific and Atlantic islands, and parts of West and South Africa [*cf.* **41** 257].

Robertson (I. A. D.). **Tree-planting Trials for the Control of the Red Locust** (*Nomadacris septemfasciata*) **in the Rukwa Valley, Tanganyika.** —*E. Afr. agric. J.* **23** no. 3 pp. 172–178, 2 figs., 2 maps. Nairobi, 1958.

Since the outbreak area of *Nomadacris septemfasciata* (Serv.) in the Rukwa Valley of Tanganyika consists largely of open grassland [*cf. R.A.E.*, A **46** 369, etc.] and the locusts avoid trees, trials were begun in 1952 to ascertain whether it would be possible to establish trees in the grassland as a measure of ecological control. The area is generally unfavourable for tree growth, but some success was achieved and the results obtained with the various species tried are reviewed. *Melia azadirachta* and *Tamarindus indica* proved to be the most suitable, and *Eucalyptus camaldulensis* showed some promise.

Report of the Desert Locust Survey and Control, 1st January, 1953–30th June, 1955.—[1 +] 70 pp., 3 figs., 4 maps (1 fldg. in pocket). Nairobi, E. Afr. High Comm., 1956.

This report of the work of the Desert Locust Survey and the Desert Locust Control Organisation against *Schistocerca gregaria* (Forsk.) in East Africa and the Middle East between 1st January 1953 and 30th June 1955 [*cf. R.A.E.*, A **44** 73] includes a section on the course of the outbreaks and the organisation of control measures by J. S. Hewitt (pp. 16–42). Control was in general by means of bran bait containing 0·1 per cent. γ BHC, applied against the hoppers, and the work was at times hampered by abnormal weather, which hindered or prevented campaigns and rendered forecasts unreliable, by tribal opposition, and by political factors.

In the first part of 1953, campaigns in the Somali Peninsula and Ethiopia were largely successful, though oviposition was heavy in east-central Ethiopia in April, and the survivors among the progeny of this and the next generation, with large swarms that arrived from British Somaliland and southern Arabia in October, infested all eastern and central Ogaden by early November. In southern British Somaliland, very many hoppers hatched in late November, and in Somalia one of the heaviest invasions of the current outbreak occurred in September, after abnormally heavy rain, as a result of which young swarms covering an area of at least 500 sq. miles reached and bred in Kenya where, however, control was complete by the end of December. In Arabia, hoppers produced by immigrant swarms in Oman in February and the Aden Protectorate in May and July–August, and heavy infestations in Kuwait in April and in eastern Yemen in June–July and August–October were largely controlled, but locusts derived from unreported breeding along the coastal plain of Dhofar had mostly escaped by September, and in central and southern Yemen hoppers from widespread unreported oviposition caused considerable damage and gave rise to numerous swarms that migrated to Saudi Arabia in November and December. Exceptionally heavy hopper infestations along the coastal plains of Saudi Arabia in January and the progeny from immigrant swarms that bred in August and September were controlled, but farther east in the hills 30–40 per cent. of the infestations escaped and in northern Arabia, where infestation was extremely heavy and control often impossible, numerous swarms were formed. Swarms that arrived in the island of Socotra in November 1952 severely damaged date palms and grazing, but although only limited control was possible, all but one of the fledgling swarms were destroyed by February 1953.

In 1954, immature swarms that passed over Kenya into Tanganyika in

January returned and bred during March–June in the western highlands, where control was successful, and the north, where infestations were heavy and some swarms escaped but control was applied when they returned to breed in August and September; in one area, late-instar hoppers were destroyed by dieldrin sprays applied from the air. In Eritrea, Ethiopia and the Somali Peninsula, hopper infestations during the first part of the year were mostly controlled, though in Ethiopia and British Somaliland and in Somalia, where 25 per cent. of the territory was affected, they were very heavy; surviving swarms passed from southern Ethiopia into the Ethiopian highlands in July and after October others moved from northern Ethiopia and Eritrea into east-central Ethiopia, where there had been considerable oviposition during August, though many of the eggs had been destroyed by parasites. Failure of the short rains in October–November prevented the heavy breeding expected in Ethiopia, British Somaliland and Kenya, and, with strong winds and heavy storms, reduced it in Eritrea, and the first migrating swarms passed in early December into central Tanganyika, where they bred at the most southerly point yet recorded for this time of year. The resulting hoppers and others derived from later migrating swarms that had bred in northern Kenya were controlled except for a relatively small number of swarms that migrated from Kenya into Tanganyika. Owing to the heavy commitments in the Somali Peninsula early in 1954, operations by the Desert Locust Organisation in Saudi Arabia were restricted to the coastal strip between Jeddah and the Yemen frontier, where successive immigrations during the first six months were controlled. Very heavy oviposition took place in central and north-eastern Arabia, however, and since only limited control facilities were available there, a considerable number of swarms escaped. Very heavy hopper infestations throughout Kuwait were largely controlled by mid-May, but political conditions prevented control of serious infestations in Oman to the west of the Jebel Akhdar mountains about April and limited operations in the highlands north-east of Aden during July–October. From the summer of 1954, the campaigns in Saudi Arabia were organised on an international basis in ten operational sections, and the Desert Locust Organisation was again responsible for the coastal plain, where successive invasions during August–December were controlled, but two swarms escaped in the east, where oviposition was heavy in February–April 1955. Widespread, scattered, but light infestations in British Somaliland, southern Ethiopia, Ogaden, and Somalia early in 1955 were controlled. In northern Kenya, scattered swarms already present and others arriving from Tanganyika bred farther north than was expected and despite a vigorous campaign six swarms subsequently escaped into Ethiopia and others entered north-western Kenya, where they bred later in the year.

Spraying operations by a small aircraft unit that was set up in 1953 are described by R. C. Rainey (pp. 42–45), who also reviews the research work undertaken during the period (pp. 45–58). Research on control showed that γ BHC applied in a dust to the egg-beds at 1¼ lb. per acre for four days or at 4 oz. per acre on the day before hatching and dieldrin applied in an emulsion spray at 2 oz. per acre by low-volume exhaust equipment or from aircraft up to 14 days before hatching destroyed all the resulting hoppers. A test on a larger scale in Kenya in which dieldrin was applied to egg-beds from an aircraft showed the method to be effective but, in this case, uneconomic owing to the relatively small area occupied by the eggs. Large bands of fifth-instar hoppers were readily seen from the air and controlled by a spray prepared from an emulsion concentrate containing 16 per cent. dieldrin diluted 1:4, but spraying from the air was uneconomic for smaller bands of fourth- and fifth-instar hoppers on less open ground, although

they, too, could be detected from the air. The mortality in an extensive hopper infestation sprayed with dieldrin amounted to 370,000 hoppers and fledglings per gal. spray over a period of one week and over an area extending to 1,200 yards from the spray line. The effectiveness of sprays applied from the air against locusts in flight depended largely on the denseness of the swarms and, when DNC in oil was used, on the time taken to apply it [*cf.* **45** 318]. A DNC spray applied by aircraft to a roosting swarm in the early morning killed 220,000 locusts per gal., about three times as many as it had when applied against the same swarm in flight on the previous afternoon, and experience showed that aerial spraying was more effective against roosting than against flying swarms in the East African lowlands. The greater part of a dense swarm covering 75 sq. miles was destroyed in three weeks by sprays of 11 per cent. γ BHC applied at times when it had settled, and mortalities as high as 700,000 locusts per gal. were obtained. Control of low-flying targets was also successful. The aircraft unit was able to maintain constant contact with migrating swarms for months at a time and over a distance of 600 miles across Kenya and Tanganyika, and successive operations against single swarms were thus possible.

Gérin (L.). **A propos des chenilles d'*Anaphe venata* Btlr. (Lépid. Thaum.) nuisibles aux colatiers du Cameroun.**—*J. Agric. trop. Bot. appl.* **4** no. 9–10 pp. 442–445, 1 pl. Paris, 1957.

In connection with a recent paper on the pests of *Cola* in French West Africa [*R.A.E.*, A **46** 406], the author states that *Anaphe venata* Btlr. defoliates the trees at intervals of 3–4 years in the Bamiléké region, in the west of the French Cameroons. The adults emerge in the dry season, mostly in the first ten days of February, and oviposition begins a few days after pairing has occurred. The eggs are laid on the leaves, in a mass of hairs, and hatch in a month or more. The larvae are gregarious, feed in compact groups on the lower surfaces of the leaves and become full-fed in the middle of the wet season, by which time most of the leaves have been destroyed. They then move in procession down the trees in the morning and up again in the evening, and finally, about mid-August, construct cocoons within a communal nest, the construction of these requiring about a fortnight.

The trees are mostly situated along roads and tracks and in villages. Collection of the nests was recommended for control in 1953, but proved unpopular, and tests with insecticides were begun in 1954. Sprays and dusts containing 8–10 per cent. DDT or BHC were applied, but the results were very uneven; young larvae were much more susceptible than older ones. Numerous parasites were observed, but the prospects of increasing their effectiveness are remote.

Nour-Eldin (F.) & Bishay (F.). **Presence of the Tristeza Virus Disease in Egypt.**—*FAO Plant Prot. Bull.* **6** no. 10 pp. 153–154, 1 fig., 3 refs. Rome, 1958.

Tristeza disease was observed in *Citrus* in Egypt for the first time in October 1957, when it was found in trees in a varietal plot at the Barrage Experiment Station. Of the known vectors of the virus, *Toxoptera citricidus* (Kirk.) does not occur in the country, but *Aphis gossypii* Glov. is present [*cf. R.A.E.*, A **44** 332]. There is no evidence of spread of the infection to commercial plantings.

Hussein (K. K.). **The Effect of Insecticides on Outbreaks of Spider Mites on Cotton.**—*FAO Plant Prot. Bull.* **6** no. 10 pp. 155–157. Rome, 1958.

Appreciable damage to cotton in Jordan by Tetranychids was observed for the first time in 1955, when an outbreak developed at an experiment station in the Jordan Valley on a plot that had been sprayed with endrin against *Earias insulana* (Boisd.). Observations in 1955–57 showed that the mites were widespread in the area and that *Tetranychus telarius* (L.) was the predominant species. The mites overwinter on *Malva* sp. and *Convolvulus arvensis* and infest vegetable crops at the end of winter, when the temperature and air humidity increase. On tomato, the population reaches its peak in April and May, when the fruits are set, and heavy infestation reduces the fruiting period and the yield. However, watermelon suffers most. The mites appear on cotton in April, when the plants are 30–40 days old, reach peak numbers between May and July, according to weather, and decrease in August. Sudden outbreaks cause considerable damage, but in 1956 they were observed only in fields that had been treated with endrin, the population remaining low in untreated areas.

In an experiment in 1957, plots in a field of cotton were sprayed with 0·3 per cent. endrin, 0·08 per cent. Gusathion [O,O-dimethyl S-(4-oxo-benzotriazino-3-methyl) phosphorodithioate], 0·7 per cent. aldrin or 1 per cent. DDT at about 80 gals. per acre on 16th May (when *E. insulana* first appeared), on 30th May and on 15th June. The mites were first observed on 15th April, but did not become numerous until the end of May, about a fortnight after the first spraying date, when numbers increased rapidly on treated plots and also on the untreated one, which was surrounded by the others, and reached a peak about 9th June. The increase was most noticeable on the plants sprayed with endrin or aldrin. To test the effect of an acaricide, 0·05 per cent. Systox [diethyl 2-(ethylthio)ethyl phosphorothioate (demeton)] was added to all the insecticides on 15th June, after which the populations fell abruptly on all plots, including the unsprayed one. Coccinellids were observed feeding on all stages of the mites during the experiment, and they were about eight times as numerous on the untreated plot as on the one sprayed with endrin. The experimental field was surrounded by unsprayed cotton, and it was found that spraying led to an increase in mites on this for a distance of 5 but not 100 metres, which may explain the increase on the control plot in the field. In non-treated areas, the population remained low throughout the season.

Outbreaks and new Records.—*FAO Plant Prot. Bull.* **6** no. 10 pp. 158–159. Rome, 1958.

W. J. Hall reports (p. 159) that *Aphis craccivora* Koch has been observed for the first time in Fiji, on *Gliricidia maculata* near the air base at Suva Point, having presumably been introduced by aeroplane from New Zealand.

Nishida (T.) & Bess (H. A.). **Studies on the Ecology and Control of the Melon Fly *Dacus (Strumeta) cucurbitae* Coquillett (Diptera: Tephritidae).**—*Tech. Bull. Hawaii agric. Exp. Sta.* no. 34, 44 pp., frontis., 19 figs., 3½ pp. refs. Honolulu, 1957.

Dacus cucurbitae Coq. is a serious pest of tomato and cucurbits in Hawaii, and the damage caused by oviposition and larval feeding in the fruits is often followed by decomposition due to secondary organisms; monthly surveys in 1951 showed that 2–40 per cent. of the tomatos and 10–100 per cent. of the cucumber fruits were injured in one locality on Oahu.

Methods that have been adopted for control of the fruit-fly are reviewed, including the use of protective coverings on the fruits, the growing of resistant varieties or trap crops and the practice of field sanitation to prevent breeding, the introduction of natural enemies from abroad and the use of insecticides, and it is concluded that a combination of cultural and chemical control is the most promising; protective covers are effective but expensive, because of the labour involved, and biological control with *Opius fletcheri* Silv. is successful only in wild areas, where fruit-fly breeds in the fruits of *Momordica balsamina* [*cf. R.A.E.*, A **45** 230]. The life-history of *D. cucurbitae* is summarised, together with the results of ecological studies on the movements and distribution of the adults [*cf.* **39** 239] and on the behaviour of the ovipositing females, including the distributional patterns of punctured fruits in the field and the variations in oviposition in different crops and at different times of day.

As adult populations are usually higher outside than within crop fields, spraying the plants with which the adults are associated, rather than the crop to be protected, is considered the best means of control, and experiments are described in which this proved effective. Spraying border plants favoured by the adults with DDT or parathion by means of a mist blower or conventional sprayer afforded good protection of tomato and cucumber fields [*cf.* **43** 16, 39] and treating plants bordering watermelon fields with 0·5–4 per cent. malathion in an emulsion spray, applied with a mist blower when trap catches indicated increases in population, reduced both the adult population and the damage to the seedlings, terminal shoots and young fruits in 1957. Reference is also made to work in progress on the use of bait-sprays [*cf.* **46** 446, etc.].

Shepard (H. H.). Ed. **Methods of testing Chemicals on Insects. Volume I.**—$8\frac{3}{4} \times 5\frac{1}{2}$ ins., [4+] iv + 356 pp., 43 figs., $28\frac{1}{2}$ pp. refs. Minneapolis, Minn., Burgess Publ. Co., 1958. Price £2 or $5.

This first volume of a series consisting of review articles by various authors on methods available for laboratory studies of different aspects of the action of chemicals on insects is devoted to investigation of the effects of the compounds on insect physiology and to general techniques for their application. The subjects dealt with are **Surface Phenomena in Relation to Insect Cuticle,** by W. M. Hoskins (pp. 1–16), who considers the effect on the functioning of the cuticle of contact of insecticides with the outermost layer; **Penetration of Cuticle,** by A. G. Richards (pp. 17–34, 4 figs.); **Measurement of Insect Respiration,** by R. Craig (pp. 35–44); **Electrophysical Preparations in the American Cockroach,** by K. D. Roeder & E. A. Weiant (pp. 45–60, 2 figs.), in which instructions are given for making preparations of the nervous system of *Periplaneta americana* (L.) for studies of nerve activity by electrical methods; **Study of the Circulatory System in Insects,** by R. L. Patton (pp. 61–75); **Radioactive Tracer Methods,** by A. W. Lindquist (pp. 76–82); **Resistance Studies,** by W. V. King (pp. 83–91), who deals with the determination of resistance to insecticides in insects and the production of resistant laboratory strains; **Methods of topical Application and Injection,** by R. L. Metcalf (pp. 92–113, 3 figs.); **Feeding and Drinking Methods,** by F. W. Fisk (pp. 114–129); **Dipping Methods,** by A. H. McIntosh (pp. 130–153, 1 fig.); **Precision Spraying,** by C. Potter & M. J. Way (pp. 154–258, 14 figs.), in which forms of apparatus designed for the accurate application of sprays to insects or to leave films on surfaces are described and factors influencing the results discussed; **Precision Dusting,** by J. E. Dewey (pp. 259–274, 4 figs.); **Testing Fumigants,** by R. T. Cotton (pp. 275–313, 13 figs.); and **Synergism and Antagonism,** by N. Turner (pp. 314–324,

2 graphs), who reviews the types of joint action of ingredients in toxicant mixtures and methods of determining them.

Distribution Maps of Insect Pests.—Series A, nos. 91–96. London, Commonw. Inst. Ent., 1958.

These maps are nos. 91–96 of a series already noticed [*R.A.E.*, A **40** 203; **46** 240] and deal, respectively, with *Aleurocanthus woglumi* Ashby, *Coccus hesperidum* L., *Pseudococcus adonidum* (L.), *Iridomyrmex humilis* (Mayr), *Solenopsis geminata* (F.) and *S. saevissima* (F. Sm.) (including *S. saevissima richteri* Forel). In connection with the distribution of *A. woglumi*, it is stated that records of its occurrence in Hawaii are apparently derived from a statement in the Report of the U.S. Bureau of Entomology for 1930–31 that work on the biological control of this insect included the establishment there of colonies of its parasite, *Eretmocerus scrius* Silv. [*cf. R.A.E.*, A **20** 218]. It seems likely that "Hawaii" in this report was a misprint for "Haiti", as Dr. E. C. Zimmerman has no record of either host or parasite in Hawaii.

Papers noticed by Title only.

Huffaker (C. B.). **Fundamentals of Biological Control of Weeds.**—*Hilgardia* **27** no. 3 pp. 101–157, 4 figs., 7 pp. refs. Berkeley, Cal., 1957.

Batt (R. F.) & Martin (J. T.). **The Micro Determination of DDT** [on leaves or in soil].—*Rep. agric. hort. Res. Sta. Bristol 1956* pp. 127–130, 1 graph, 2 refs. Long Ashton [1957].

Skerrett (E. J.) & Baker (E. A.). **The Determination of Spray Deposits of Chlorobenzilate** [ethyl 4,4′-dichlorobenzilate].—*Rep. agric. hort. Res. Sta. Bristol 1956* pp. 130–134, 2 graphs, 3 refs. Long Ashton [1957].

Krombein (K. V.) & others. **Hymenoptera of America north of Mexico: synoptic Catalog. First Supplement** [including new names and synonymy].—*Agric. Monogr. U.S. Dep. Agric.* no. 2 (suppl.), $9\frac{1}{4} \times 6$ ins., [1+] 305 pp. Washington, D.C., 1958. Price $1.75. [*Cf. R.A.E.*, A **39** 292.]

Narcissus Pests [in Britain].—*Bull. Minist. Agric.* no. 51 (5th edn.), iv + 37 pp., col. frontis., 8 pls., 2 figs., 41 refs. London, H.M.S.O., 1958. Price 4*s.* 6*d.* [*Cf. R.A.E.*, A **41** 32, etc.]

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